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West Virginia Univ., Morgantown

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GROSS REGIONAL PRODUCT IN THE OHIO RIVER BASIN ENERGY STUDY REGION 1960-1975

by

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16. ABSTRACT

This report was prepared as part of the Ohio River Basin Energy Study (ORBES), a multi-disciplinary research program supported by the U.S. Environmental Protection Agency. Sharing techniques are used to determine the gross product of the six ORBES states and ORBES-region state shares. The region consists of all of Kentucky, most of West Virginia, substantial parts of Illinois, Indiana and Ohio, and southwestern Pennsylvania.

The following information is reported: (1) Baseline data (1975) on the economic characteristics of the ORBES region relative to the six states and the United States. This is done by estimating gross product as well as gross product originating in aggregated sectors. (2) Estimations of historical gross product growth rates for the ORBES region, the six-state area and the United States, 1960-75. Sectoral growth rates also are calculated for the same areas and time interval. (3) Those sectors in the region experiencing high growth rates compared to the six-state area and the United States, 1960-75.

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FOREWORD

The Ohio River Basin Energy Study (ORBES) is an interdisciplinary, multi-university inquiry into the environmental, economic, and social impacts of energy facility development in a major portion of the Ohio River Basin. The study was initiated by the U.S. Environmental Protection Agency in 1976 in response to a directive from the U.S. Senate Appropriations Committee.

Most of the ORBES research was conducted by a group of faculty members at the University of Illinois, Indiana University, the University of Kentucky, the University of Louisville, The Ohio State University, the University of Pittsburgh, Purdue University, and West Virginia University. In a few instances, the necessary expertise was found at other universities or independent research organizations.

This report is one of a series produced in support of the overall ORBES assessment. For a summary of the entire study, see Ohio River Basin Energy Study (ORBES): Main Report, by the ORBES Core Team, also being published by the U.S. Environmental Protection Agency.

PREFACE

This is a final report of work completed on a subcontract between West Virginia University and the University of Illinois titled "Estimating Gross Regional Product for the Ohio River Basin Energy Study (ORBES) Region." Walter P. Page, West Virginia University, served as principal investigator.

Because of funding limitations, this work is methodologically crude. That is to say, no effort is made to construct an empirically based econometric model of the region or of particular industries within the region. Rather, sharing techniques are used to determine state gross product and ORBES-region state shares for estimating regional historic growth rates for the period 1960-1975. The scope of work and funding level were determined by the ORBES project Core Team.

We wish to thank John Uribe, Kyung Hun Lee, and Mahmood Moghimzadeh for assistance with the calculations. Special thanks are extended to Mary Ann Albertazzie for her competent typing services and cooperative attitude and to the Bureau of Business Research, West Virginia University, for managing the subcontract.

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SECTION 1

INTRODUCTION

The Ohio River Basin Energy Study (ORBES) is charged with assessing "...the potential environmental, social, and economic impacts of the proposed concentration of power plants in the lower Ohio River Basin." Phase II of the study, spanning a two-year period ending October 31, 1979, focuses on a regional analysis consistent with the above mandate. In Phase II, the study region is defined to include all of Kentucky and portions of Illinois, Indiana, Ohio, Pennsylvania, and West Virginia (see Figure 1). Among technology assessments, the project is unique with respect to its regional focus; the study region is not simply the sum of six states. Regional boundaries for Phase II were determined in such a way as to include desired portions of (1) the Ohio River drainage basin and (2) regional coal provinces.

To the same extent that the project is unique among technology assessments, the modeling needs of the study also are unique. Particularly noteworthy is the main frame of the integrated assessment, which is composed of a set of market models designed to provide a consistent set of projected fuel and energy demands, by fuel type and end user, within the region for the year 2000. These are identified as "scenario" models. Alternative scenarios (futures) with respect to fuel and energy use are formulated for the year 2000 in order to provide a set of "plausible" futures for analysis of associated environmental, health, social, and economic impacts.

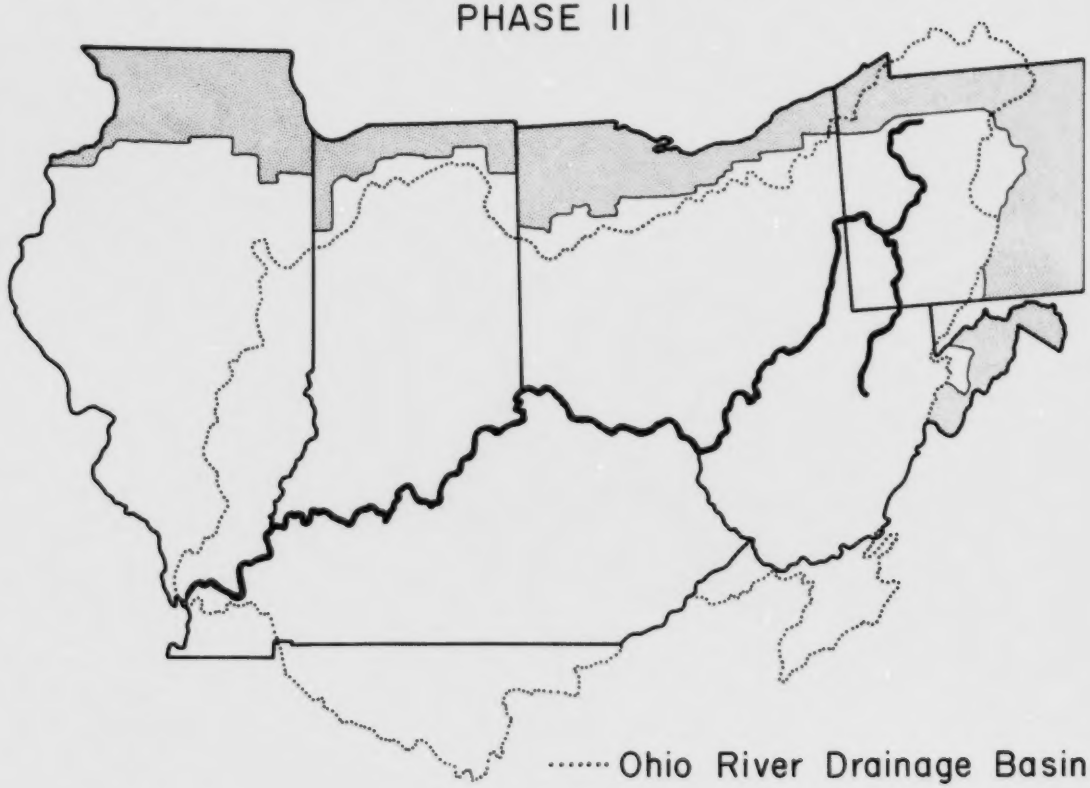
To carry out the scenario modeling requirements of the ORBES project, certain pieces of information are required as input data. Among other parameters is the need for regional (ORBES) and national data on (1) baseline economic conditions, (2) historical patterns of economic growth, and (3) which economic sectors are, relatively speaking, growing more rapidly than others.

In particular, the energy and fuel demand model requires baseline information on gross product as well as data for the estimation of year 2000 gross product, both regionally and nationally. This work provides baseline values and growth rates that can be used by ORBES researchers to estimate year 2000 national and regional gross product. Because only historical data is provided (there is no regional forecasting model), presumably such estimates will be based on the 1960-1975 trend values observed for national and regional gross product. Further, those working with the energy and fuel demand model are convinced that changes in the composition of gross regional and national product may yield some of the more interesting changes in year 2000 consumption of fuels and energy. To explore this question, information is required that points out which regional and

FIGURE I

OHIO RIVER BASIN ENERGY STUDY REGION

PHASE II



national sectors have been growing, relatively speaking, more rapidly than others. With this information, year 2000 estimates of gross product, regional and national, can be adjusted to conform to the distribution of final product implied by the relative sectoral growth rates, 1960-1975.

The purpose of this subcontract, then, is to provide the above information by means of three tasks:

(1) Provide baseline information (1975) on the economic characteristics of the region relative to the six-state ORBES area and the United States. This is done with estimates of gross product as well as gross product originating in aggregated sectors.

(2) Estimate historical gross product growth rates for the ORBES region, the six-state area, and the United States, 1960-1975. Sectoral growth rates are also calculated for the same regions and time interval.

(3) Identify and discuss which sectors in the region have experienced relatively high growth rates compared to the six-state area and the United States, 1960-1975.

To perform these tasks, state gross product for each of the six states is estimated for 1960, 1965, 1970, and 1975; ORBES-region shares in each state's gross product is also estimated. The gross product estimates for each state are then aggregated for an estimate of six-state gross product in each year. Similar aggregation procedures are followed for the estimation of ORBES-regional gross product. Based on these calculations, the six-state, ORBES region, and United States gross products are compared for the baseline year, 1975. Comparisons are made with respect to sectors of each region's economy as well as to total gross product. Using the four years for which calculations were performed, average annual compounded growth rates are then calculated, in toto and for each sector, to provide estimates of historic growth experience by region. Finally, average annual compounded growth rates for each sector and the percentage contribution, by industry, to regional gross product growth are calculated.

Because the analysis is essentially regional in nature, all tables relating to individual state gross product and ORBES-region shares in each state's gross product are placed in Appendix A. Figures showing ORBES region shares in state gross product, 1975, are placed in Appendix B. The details of the methodology for calculating state gross product and ORBES region shares may be found in Appendix C. All regional tables and figures, however, are integrated with the discussion and interpretation found in the text.

SECTION 2

BASELINE REGIONAL GROSS PRODUCT, 1975

To calculate ORBES-regional gross product for a given year, it is necessary to (1) estimate state gross product for each of the six states wholly or partly in the ORBES region (see Figure 1) and (2) to apportion the ORBES-region share of each state's gross product. Because gross product estimates by industry are not maintained in a consistent fashion (if at all) by states, it is necessary to use an approximating procedure for estimating gross state product. Because in general economic data are not gathered below the state level, it is also necessary to apportion the estimated state gross product to those counties of each state within the ORBES region. The details of both approximating procedures are provided in Appendix C.

In general, adequate procedures exist to estimate state gross product as well as partial state shares (the ORBES region). If economic data were adequate, one would use value-added data for both approximating procedures (see Appendix C). Because substate value-added data are not reported regularly for most sectors, however, it is necessary to use value-added data for approximating state gross product and employment data for approximating ORBES state shares. While employment weights for substate allocations leave something to be desired, we have checked the comparative results for manufacturing and mining as between using employment or value-added weights for estimating ORBES state shares; we found little difference. As a consequence, we are reasonably confident that the use of employment weights for estimating ORBES state shares is a legitimate procedure in this case.

Using the estimation procedures discussed in Appendix C, we obtained a set of tables (1960, 1965, 1970, and 1975) for gross state product and ORBES-region state shares for Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia. These tables are reported in Appendix A; they form the basis of all subsequent regional calculations, other than United States data, reported in the text. United States data are taken from standard statistical sources as identified in table notes.

For each year and each state, values are reported for the following sectors: government, farm, private non-farm (mining, construction, manufacturing, trade, finance-insurance-real estate, transportation-communication-utilities, and services and other). Total gross product is also reported for each year and each state. Because we are interested in the "real" value of gross product (as well as the amount originating in each sector), it is necessary to deflate current dollar estimates by implicit price deflators. For this purpose, constant 1972 dollars are used. Implicit price deflators, by industry, are calculated only at the national level. Therefore, the same

deflators are used for establishing current dollar values for state, ORBES-region, six-state and United States data. These deflators are reported in Table 1. In the remainder of this section of the report, we discuss the baseline gross product data (1975) for the ORBES region, the six-state area, and the United States.

Using Tables A-19 to A-24, state and ORBES-region current dollar values may be aggregated to form the six-state and ORBES regional current dollar columns in Table 2. Applying the deflators from Table 1 to the six-state and ORBES-region current dollar value data, we obtain the constant dollar columns in Table 2. This table, then, provides the current dollar regional industry data for comparison of the baseline economic experience among the ORBES region, the six-state area, and the United States. Figure 2 is a graphic representation of the data from Table 2. The individual state and ORBES share characteristics from Tables A-19 to A-24 are also graphically presented in Figures B-1 and B-6.

While ORBES-region shares of state economic activity varied from a high of 100% (Kentucky, Table A-21) to a low of 25% (Illinois, Table A-19) in 1975, for the ORBES region as a whole economic activity (that is gross product) is approximately 48% of the six-state area gross product. As shown in Figure 2, this percentage share is approximately the same for all sectors except farming and mining. In the case of farming, the ORBES-region value is 77% of the six-state area value; for mining, this value is 86%. Other sectors vary from a low of 42% to a high of 53% of the six-state values. Hence, relative to other sectors, the ORBES region contains a disproportionately large amount of the farm and mining activity in the six-state area. In terms of economic activity, this fact is not particularly important, given that farming contributes only 4% to gross product in the ORBES region (3% in the six-state area) and mining, 3% to ORBES-region gross product (2% for the six-state area). From the point of view of environmental impacts and end uses of energy, however, the disproportionate share of mining in the ORBES region may be highly significant. For instance, this concentration suggests that the region, relative to the six-state area, bears more heavily the impacts on the environment, health, etc. associated with coal-mining activity. Further, due to the significant cost of coal transport, the concentrated mining activity within the ORBES region suggests that, relative to the six-state area, the region would rely more on coal as a primary fuel source. In fact, this is the case; coal consumption in the ORBES region was 48% of total primary fuel use in 1974, while the corresponding figure for the six-state area was 40% (see preliminary report by Walter P. Page, "Energy Consumption in the ORBES Region, 1974, by End User and Fuel Type," November 1978). This further suggests, then, that the impacts on the environment, health, etc. associated with coal combustion will be greater in the ORBES region than in the six-state area.

It is also of some interest to note that the per capita gross product in the ORBES region is less than that of the six-state area. Population in

TABLE 1

IMPLICIT PRICE DEFLATORS FOR
GROSS NATIONAL PRODUCT, BY INDUSTRY

(1972 = 100)

Industry	1960[1]	1965[1]	1970[1]	1975[2]
Government	.497	.602	.848	1.232
Farm	.685	.730	.833	1.455
Private Non-Farm				
Mining	.875	.820	.915	2.024
Construction	.499	.570	.842	1.338
Manufacturing	.837	.835	.961	1.272
Trade	.717	.759	.938	1.298
Finance, Insurance, Real Estate	.689	.752	.918	1.174
Transportation, Communication, Utilities [3]	.784	.803	.896	1.187
Services and Other	.598	.699	.910	1.278

1. National Income and Product Accounts of the United States, 1929-74, U.S. Department of Commerce, Bureau of Economic Analysis, Washington, D.C., 1975.

2. Survey of Current Business, July 1976.

3. Weighted average of three price deflators for transportation, communication, and utilities, weighted by employment.

TABLE 2

GROSS PRODUCT BY REGION, 1975

(1972 = 100)[1, 2]

(millions of dollars)

Industry	ORBES		SIX STATES		UNITED STATES[5]	
	Current[3] Dollars	Constant Dollars	Current[4] Dollars	Constant Dollars	Current Dollars	Constant Dollars
Government	17,293.7	14,037.1	32,468.6	26,354.4	200,600	162,300[7]
Farm	7,376.2	5,069.6	9,537.0	6,554.6	54,800	37,700[8]
Private Non-Farm	(132,549.9)	(103,189.2)	(278,984.6)	(219,432.8)	(1,260,900)	(991,500)
Mining	7,200.8	3,557.7	8,582.6	4,240.4	37,600	18,700
Construction	6,637.0	4,960.4	13,554.0	10,130.0	66,500	49,000
Manufacturing	47,697.8	37,498.3	99,168.9	77,963.0	346,000	270,000
Trade	25,744.1	19,833.7	54,308.3	41,840.0	272,400	211,100
Finance, Insurance, Real Estate	16,085.9	13,701.8	38,557.3	32,842.7	209,400	180,200
Transportation, Communication, Utilities[6]	13,357.1	11,252.9	28,371.4	23,901.8	132,200	111,500
Services and Other	15,827.2	12,384.4	36,442.1	28,514.9	196,800	151,000
TOTAL	157,219.8	122,295.9	320,990.2	252,341.8	1,516,300	1,191,500

(continued)

TABLE 2 (continued)

1. The ratio of ORBES real product to the six-state real product is 48%.

2. Implicit price deflators (1972 = 100) by industry taken from The National Income and Product Accounts of the United States, 1929-74, U.S. Department of Commerce, Bureau of Economic Analysis, U.S. Government Printing Office, Washington, D.C., and Survey of Current Business, July 1977, Table 7.15.

3. Sum of current dollar estimates for ORBES portion of each state. See Appendix A for data sources.

4. Sum of current dollar estimates for each state. See Appendix A for data sources.

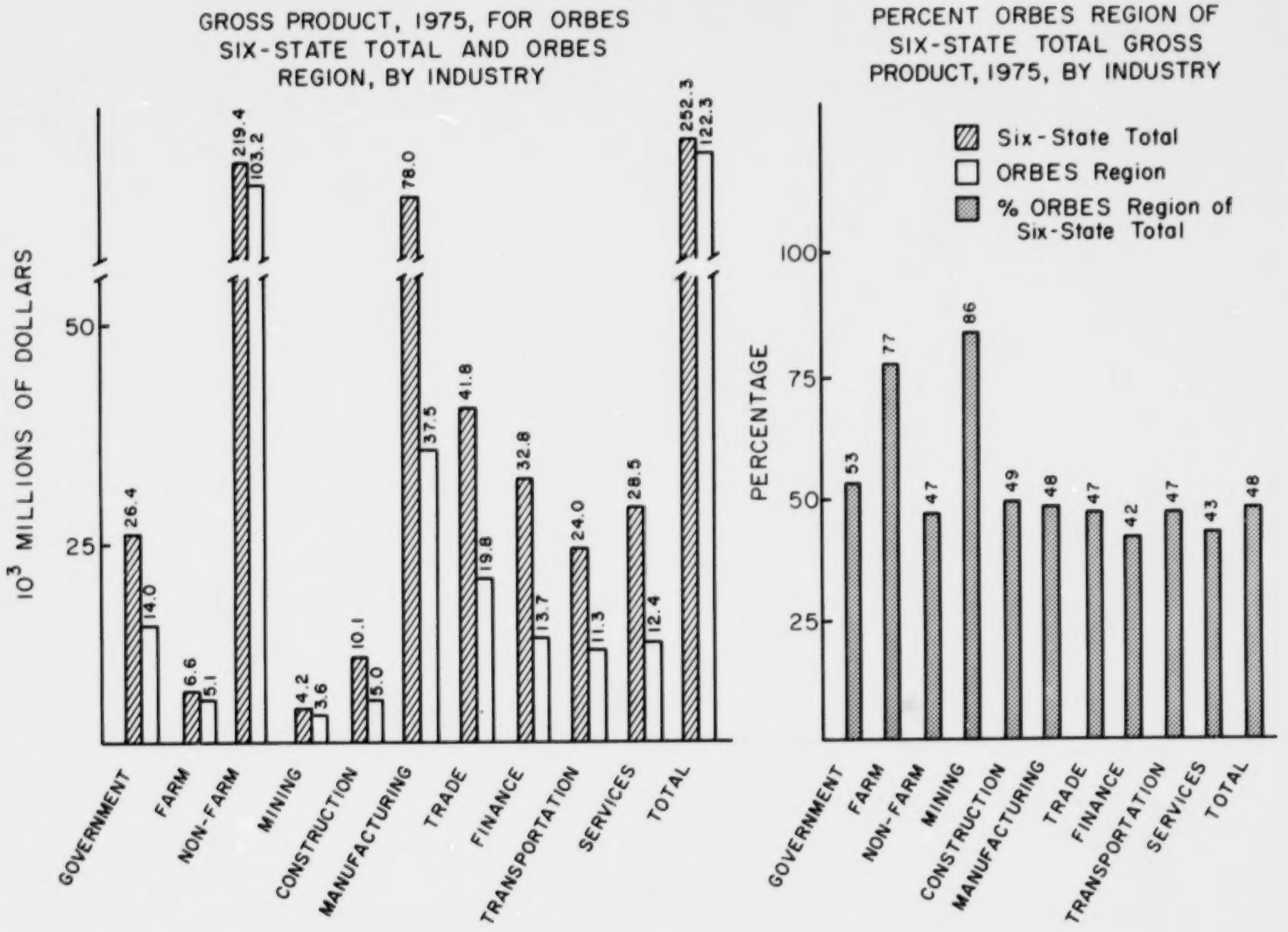
5. United States data from Statistical Abstract of the United States, 1977, Table 693, p. 430, U.S. Government Printing Office, Washington, D.C.

6. Weighted average of price deflators for transportation, communication, and utilities by employment.

7. Government and government enterprises.

8. Agriculture, forestry, and fisheries.

FIGURE 2


GROSS PRODUCT, 1975, FOR ORBES SIX-STATE TOTAL AND ORBES REGION, BY INDUSTRY
10^3 MILLIONS OF DOLLARS
50
25
26.4
14.0
6.6
5.1
219.4
103.2
4.2
3.6
10.1
5.0
78.0
37.5
41.8
19.8
32.8
13.7
24.0
11.3
28.5
12.4
252.3
122.3
GOVERNMENT
FARM
NON-FARM
MINING
CONSTRUCTION
MANUFACTURING
TRADE
FINANCE
TRANSPORTATION
SERVICES
TOTAL
PERCENT ORBES REGION OF SIX-STATE TOTAL GROSS PRODUCT, 1975, BY INDUSTRY
Six-State Total
ORBES Region
% ORBES Region of Six-State Total
PERCENTAGE
100
75
50
25
53
77
47
86
49
48
47
42
47
43
48
GOVERNMENT
FARM
NON-FARM
MINING
CONSTRUCTION
MANUFACTURING
TRADE
FINANCE
TRANSPORTATION
SERVICES
TOTAL

the ORBES region in 1975 was 23,489,129; in the six-state area, 44,301,789.[1] This produces a per capita gross product in the ORBES region of approximately $5204 for 1975, compared to a six-state per capita gross product of $5695.

The regional data for 1975 reported in Table 2 and Figure 2 mask, of course, considerable variation across the six states wholly or partly in the ORBES region. Again, these data are reported in Tables A-19 to A-24 and Figures B-1 to B-6. From Tables A-19 to A-24, for instance, the contribution of each state to the six-state gross product (Table 2) ranges from a low of 3% (West Virginia) to a high of 29% (Illinois). The three largest, in percentage contribution to six-state gross product, are Illinois (29%), Pennsylvania (25%), and Ohio (24%), while West Virginia (3%), Kentucky (6%), and Indiana (12%) are the smallest contributors. Given the ORBES boundaries, however, a very different pattern emerges when one considers the percentage contribution of the ORBES portions of each state to the ORBES total regional product. Particularly dramatic is the drop in state shares for Illinois and Pennsylvania (from 29% to 15% and from 25% to 15%, respectively). Similarly dramatic is the increase in state shares for Kentucky and West Virginia (from 6% to 13% and from 3% to 6%, respectively). These differences arise, of course, from excluding the primary centers of economic activity from the ORBES region, particularly in the case of Illinois. In the case of Pennsylvania, a major center of economic activity is included in the ORBES region, but several other major areas within the state are excluded. This is confirmed by Tables A-19 and A-23, where one finds that the ORBES-region portion of Illinois gross product is only 25% of state gross product; in the case of Pennsylvania, the share is 28%. Considering the geographic boundaries of the ORBES region, these two states are dramatically different from the four other ORBES states. Of the four other states, the ORBES-region portion of state product ranges from 100% (Kentucky) to 65% (Ohio). The two states, then, with the largest state gross product have the smallest percentage for the ORBES share of state product. As a consequence, the ORBES-region gross product is substantially reduced relative to the six-state total gross product.

Another way to view the matter is in relation to the two states with the smallest state gross product contribution to the six-state gross product. These states are Kentucky (which contributes 6% to the six-state gross product) and West Virginia (which contributes 3%). In the case of Kentucky (Table A-21), the contribution to ORBES-region gross product is more than double the contribution to the six-state product (13% compared to 6%). In the case of West Virginia, the percentage contribution exactly doubles (from 3% to 6%).

As a result of the above considerations, then, it may be said that the boundaries for the ORBES region, particularly in the case of Illinois and Pennsylvania, are drawn in such a way as to substantially reduce gross regional product (relative to six-state product) and to "weight," as it were, the regional gross product more heavily by states with relatively smaller

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[1] Current Population Reports, U.S. Department of Commerce, Bureau of the Census, Washington, D.C., April 1977.

state gross products (Kentucky and West Virginia). Of some interest also is the variation among the states in mining activity, as shown in the six-state gross product and the ORBES-region gross product. This is particularly important in light of other ongoing ORBES work on coal supply regions and estimated coal demands in the year 2000. As noted earlier, mining may contribute only a small percentage to gross product, but the environmental impacts associated with the coal fuel cycle are of particular importance to the ORBES region. One must recall that the region includes almost all of Appalachian Province as well as the Eastern Interior Province. Examining the state tables (Tables A-19 to A-24), the ORBES-regional share of mining in each state is very large relative to other sectors in the gross product tables. Percentages of ORBES shares in total state sector values are 71%, 66%, 100%, 67%, 75%, and 94% for Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia, respectively. For all states, then, the mining sector within the ORBES region is a very important potential consideration relative to environmental impacts and energy sources within the region.

Although of less interest to this project, statements similar to those above can be made with respect to the farm sector. However, the results are more mixed among the ORBES-region states. For the region as a whole, farm activities are the second largest (77%) percentage of the six-state totals for economic activities in all sectors (Figure 2). For the individual states, the ORBES portion of farming activity is the largest percent of total state activity, by industry, for Illinois, Indiana, and Ohio. For the farm sector in three of the ORBES states, then, an inordinately large percentage of activity falls within the ORBES region, so much so that 77% of the dollar value of agricultural activity in the six states is contained within the ORBES region (compared with 48% of total economic activity). With respect to potential agricultural impacts of solid, liquid, and gaseous residuals, this may well be a significant fact; similarly with respect to land utilization within the region (e.g., stripping versus agricultural activity).

In examining regional baseline economic characteristics, it is also of interest to note the percentage contribution to gross product of the various sectors. Table 3 contains the calculations for 1975 contributions to regional gross product; Figure 3 is a graphic representation of the 1975 data. As is the case with the United States and the six-state area, the non-farm sector overwhelms all other sectors (83%, 87%, and 84% for, respectively, the United States, the six-state area, and the ORBES region). It is of interest, nevertheless, that the ORBES region appears to generate less gross product in tertiary activities (trade, finance, and service) than does the United States or the six-state area (Figure 3). Also, as suggested above, the ORBES-region share of gross product in farming and mining is greater than that in the United States or the six-state area. These data represent, of course, a point in time (1975) and do not capture the significance of sectoral shifts over time, a point to be discussed below. From the 1975 data, one would conclude that the ORBES region has less activity in the tertiary sectors than would be true of the United States or the six-state area and is more oriented toward the agricultural and mining sectors than either the United States or the six-state area. Of some

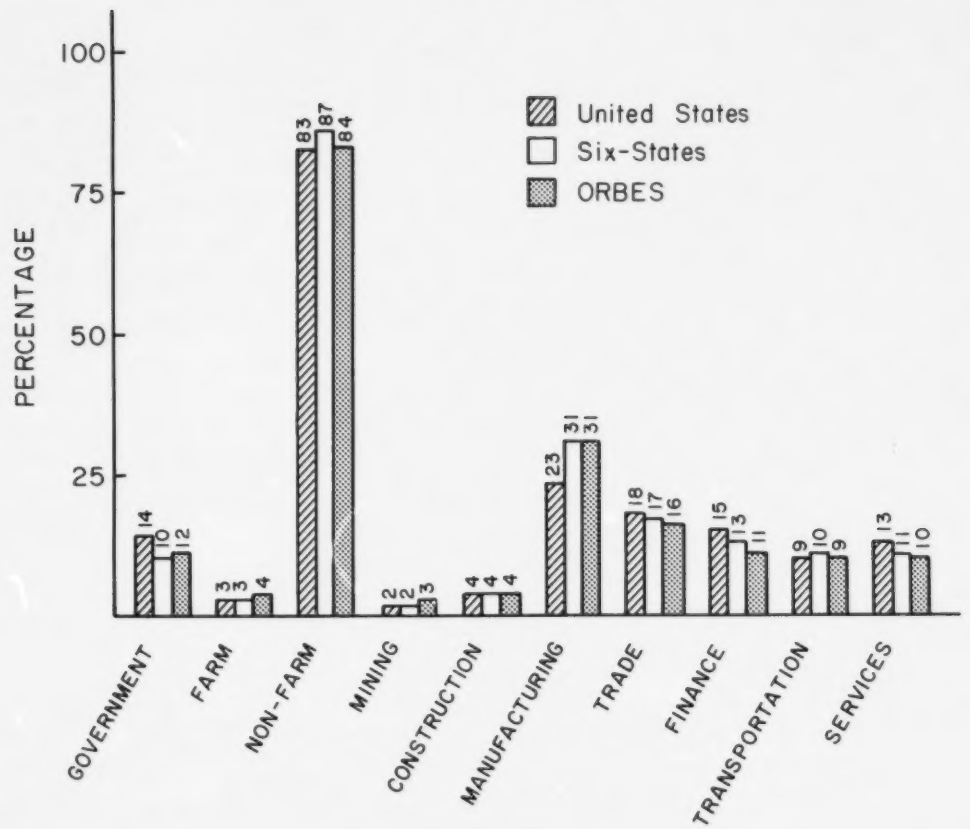
TABLE 3

PERCENT CONTRIBUTION, BY INDUSTRY, TO REGIONAL GROSS PRODUCT, 1960-1975

(1972 = 100)

Industry	ORBES				SIX STATES				UNITED STATES			
	1960	1965	1970	1975	1960	1965	1970	1975	1960	1965	1970	1975
Government	10	10	11	12	10	10	10	10	15	14	14	14
Farm	5	5	3	4	3	3	2	3	4	4	3	3
Private Non-Farm	85	85	86	84	86	87	88	87	81	83	83	83
Mining	3	3	3	3	2	2	2	2	2	2	2	2
Construction	6	6	6	4	6	6	5	4	6	6	5	4
Manufacturing	32	33	32	31	30	33	32	31	23	25	24	23
Trade	15	16	16	16	16	16	16	17	16	16	17	18
Finance, Insurance, Real Estate	10	10	11	11	11	12	12	13	14	14	14	15
Transportation, Communication, Utilities	8	8	8	9	9	9	8	10	8	8	9	9
Services and Other	11	10	11	10	12	11	11	11	12	12	12	13

FIGURE 3
PERCENT CONTRIBUTION, BY INDUSTRY,
TO GROSS PRODUCT, 1975
(1972 = 100)



interest is the fact that both the ORBES region and the six-state area generate more gross product from manufacturing (31% each) than does the United States (23%) (see Figure 3).

SECTION 3

REGIONAL GROSS PRODUCT GROWTH, 1960-1975

The second task under the subcontract was the estimation, in toto and by sector, of gross product growth rates. These calculations are based on data in Tables 2, 4, 5, and 6. Each of these tables, in turn, is based on data found in Tables A-1 to A-24. From Tables 2, 4, 5, and 6, we obtain point estimates, by sector and for total gross product, of ORBES-regional gross product as well as six-state gross product for 1960, 1965, 1970, and 1975. These data provide the basis for calculating historic growth rates, 1960-1975, for the ORBES region and the six-state area by sector and in toto. The United States data for each year are taken from standard statistical sources identified in the table notes.

The results of these calculations, for total gross product, are presented in Table 7 for the ORBES region, the six-state area and the United States. In all cases, growth rates are based on the formula for average annual compounded growth. While we have provided calculations in Table 7 of five-year rates, the period of interest is that spanning the years 1960-1975. This is the case for the obvious reason that the longer the time span, the less the influence of "transitory" aspects of economic growth. From Table 7, the growth rate of United States real product is identical to that of the entire post-World-War-II period (3.3%). Because this is the case, the 1960-1975 period appears to offer a reasonable approximation to the long-run trend in gross product (1946 to the present).

While there are variations in the six-state and ORBES region growth rates over five-year periods (reflecting relatively transitory phenomena), the 1960-1975 growth rates are, respectively, 2.82% and 2.47%. To the uninitiated, this difference might seem insignificant, but the reader should be reminded that over a 33-year period (the period spanned by the ORBES regional demand model), $100 in 1967 yields year 2000 values of 250.36 (2.82 rate) and 223.71 (2.47 rate), or a difference of 12% in the estimated future (year 2000) values. Hence, while the difference between the six-state area and the ORBES-region growth rates does not appear significant in absolute terms, the difference in year 2000 estimates of gross product would be markedly different as between the two rates; projected regional gross product for the ORBES region would be 12% or more overestimated if one used the six-state area growth rate. If one used the United States growth rate, the ORBES regional gross product would be overestimated to an even greater extent. As input to the ORBES regional demand model and the specification of ORBES scenarios, then, these differences in growth rates are indeed significant.

TABLE 4

GROSS PRODUCT BY REGION, 1960

(1972 = 100)[1, 2]

(millions of dollars)

Industry	ORBES		SIX STATES		UNITED STATES[5]	
	Current[3] Dollars	Constant Dollars	Current[4] Dollars	Constant Dollars	Current Dollars	Constant Dollars
Government	4,206.3	8,463.4	8,608.7	17,321.3	53,400	107,200[7]
Farm	2,881.3	4,206.3	3,759.2	5,487.9	21,500	32,200[8]
Private Non-Farm	(53,409.4)	(72,168.5)	(105,124.4)	(143,405.4)	(431,100)	(597,400)
Mining	2,154.1	2,461.8	2,625.1	3,000.1	12,600	14,400
Construction	2,594.4	5,199.2	5,156.0	10,332.7	22,700	45,600
Manufacturing	22,796.8	27,236.3	42,050.2	50,239.2	143,900	172,000
Trade	9,402.4	13,113.5	19,349.7	26,987.0	84,600	117,900
Finance, Insurance, Real Estate	5,709.8	8,287.1	12,872.9	18,683.5	70,500	102,300
Transportation, Communication, Utilities 6	5,316.4	6,781.1	11,132.3	14,199.4	45,800	58,000
Services and Other	5,435.5	9,089.5	11,938.2	19,963.5	51,000	87,200
TOTAL	60,497.0	84,838.2	117,492.3	166,214.6	506,000	736,800

(continued)

TABLE 4 (continued)

1. The ratio of ORBES real product to the six-state real product is 51%.

2. Implicit price deflators (1972 = 100) by industry taken from The National Income and Product Accounts of the United States, 1929-74, U.S. Department of Commerce, Bureau of Economic Analysis, U.S. Government Printing Office, Washington, D.C., and Survey of Current Business, July 1977, Table 7.15.

3. Sum of current dollar estimates for ORBES portion of each state. See Appendix A for data sources.

4. Sum of current dollar estimates for each state. See Appendix A for data sources.

5. United States data from Statistical Abstract of the United States, 1977, Table 693, p. 430, U.S. Government Printing Office, Washington, D.C.

6. Weighted average of price deflators for transportation, communication, and utilities by employment.

7. Government and government enterprises.

8. Agriculture, forestry, and fisheries.

TABLE 5

GROSS PRODUCT BY REGION, 1965

(1972 = 100)[1, 2]

(millions of dollars)

Industry	ORBES		SIX STATES		UNITED STATES[5]	
	Current[3] Dollars	Constant Dollars	Current[4] Dollars	Constant Dollars	Current Dollars	Constant Dollars
Government	5,503.5	9,142.0	11,850.0	19,684.4	76,700	127,400[7]
Farm	3,517.2	4,818.1	4,617.3	6,325.1	23,800	33,000[8]
Private Non-Farm	(62,664.9)	(80,885.7)	(136,011.5)	(176,020.3)	(587,700)	(765,400)
Mining	2,089.9	2,548.7	2,701.6	3,294.6	13,500	16,400
Construction	3,027.5	5,311.4	6,561.6	11,511.6	32,100	56,300
Manufacturing	26,265.6	31,455.8	55,663.2	66,662.5	196,300	235,100
Trade	11,192.3	14,746.1	24,162.3	31,834.4	112,800	148,600
Finance, Insurance, Real Estate	7,328.4	9,745.2	17,936.1	23,851.2	96,100	127,800
Transportation, Communication, Utilities[6]	6,357.2	7,916.8	14,047.3	17,493.5	60,600	74,300
Services and Other	6,404.0	9,161.7	14,939.4	21,372.5	76,300	106,900
TOTAL	71,685.6	94,845.8	152,478.8	202,029.8	688,200	925,800

(continued)

TABLE 5 (continued)

1. The ratio of ORBES real product to the six-state real product is 47%.

2. Implicit price deflators (1972 = 100) by industry taken from The National Income and Product Accounts of the United States, 1929-74, U.S. Department of Commerce, Bureau of Economic Analysis, U.S. Government Printing Office, Washington, D.C., and Survey of Current Business, July 1977, Table 7.15.

3. Sum of current dollar estimates for ORBES portion of each state. See Appendix A for data sources.

4. Sum of current dollar estimates for each state. See Appendix A for data sources.

5. United States data from Statistical Abstract of the United States, 1977, Table 693, p. 430, U.S. Government Printing Office, Washington, D.C.

6. Weighted average of price deflators for transportation, communication, and utilities by employment.

7. Government and government enterprises.

8. Agriculture, forestry, and fisheries.

TABLE 6

GROSS PRODUCT BY REGION, 1970

(1972 = 100)[1, 2]

(millions of dollars)

Industry	ORBES		SIX STATES		UNITED STATES[5]	
	Current[3] Dollars	Constant Dollars	Current[4] Dollars	Constant Dollars	Current Dollars	Constant Dollars
Government	10,032.1	11,830.3	19,828.6	23,382.8	129,100	152,000[7]
Farm	3,117.3	3,742.3	4,294.9	5,155.9	28,700	34,300[8]
Private Non-Farm	(90,853.2)	(97,701.1)	(187,659.5)	(201,797.3)	(824,600)	(889,100)
Mining	2,954.1	3,228.5	3,467.8	3,789.9	17,400	19,100
Construction	5,256.2	6,242.5	10,275.7	12,203.9	47,400	56,200
Manufacturing	35,146.5	36,572.8	71,865.6	74,782.1	250,300	260,600
Trade	17,050.1	18,177.1	35,447.5	37,790.5	167,300	178,400
Finance, Insurance, Real Estate	11,418.7	12,438.7	26,108.6	28,440.7	141,000	153,700
Transportation, Communication, Utilities[6]	7,687.3	8,579.6	16,944.6	18,911.4	85,200	95,100
Services and Other	11,340.3	12,461.9	23,549.7	25,878.8	116,000	126,000
TOTAL	104,002.6	113,273.7	211,783.0	230,336.0	982,400	1,075,400

(continued)

TABLE 6 (continued)

1. The ratio of ORBES real product to the six-state real product is 49%.

2. Implicit price deflators (1972 = 100) by industry taken from The National Income and Product Accounts of the United States, 1929-74, U.S. Department of Commerce, Bureau of Economic Analysis, U.S. Government Printing Office, Washington, D.C., and Survey of Current Business, July 1977, Table 7.15.

3. Sum of current dollar estimates for ORBES portion of each state. See Appendix A for data sources.

4. Sum of current dollar estimates for each state. See Appendix A for data sources.

5. United States data from Statistical Abstract of the United States, 1977, Table 693, p. 430, U.S. Government Printing Office, Washington, D.C.

6. Weighted average of price deflators for transportation, communication, and utilities by employment.

7. Government and government enterprises.

8. Agriculture, forestry, and fisheries.

TABLE 7

COMPARATIVE GROWTH OF REAL PRODUCT BY REGION[1]

Average Annual Compound Percent Increase
In Constant Dollars (1972 = 100)

	ORBES	Six States	United States
1960-1965	2.26	3.98	4.67
1965-1970	3.61	2.66	3.04
1970-1975	1.54	1.84	2.07
1960-1975	2.47	2.82	3.26

1. Calculations based on the following formula: $i = (FV/PV)^{1/n} - 1$. ORBES and six-states real product taken from Tables 2, 4, 5, and 6 in text. United States data taken from Statistical Abstract of the United States, 1976, Table 632, "Rates of Economic Growth: 1910-1975", p. 395. Real dollars are based on implicit price deflators by industry.

The reader must also be reminded that projections of future values based on historic trends are no substitute for adequate economic modeling. That is to say, trend analysis is probably most useful in bounding estimates for scenarios (examining high and low rates where, traditionally, historic trend is taken as "high"). For "best estimates" of future values, trend analysis is not very useful. As the ORBES project is developing high and low growth scenarios, trend analysis is probably an adequate methodology.

In examining sectoral changes over time, one is interested in shifts of economic activity as well as rates of growth. By shifts of economic activity we mean changes, over time, in the percent contribution to regional gross product. Table 3 provides the estimates, by region, for 1960, 1965, 1970, and 1975, which are necessary to examine such shifts. With respect to the ORBES region, there do not appear to be any major shifts in the basic economic structure of the region. Most sectors experienced only very small changes in percentage share in gross product over the period. Government has increased its share (from 10% to 12% in 1975), as have the tertiary sectors, but only slightly. Other than some indication of a minor structural shift toward government and tertiary sectors, the economic structure of the ORBES region appears relatively stable over the period 1960-1975. The economic structure of the six-state area also exhibits stability over the period 1960-1975 (see Table 3), with tertiary sectors realizing some slight gains. Government has been a constant percentage in the six-state area. As one would expect from the earlier discussion of regional economic conditions in 1975, other than farm and mining activity, the percentage contribution to regional product by sector is very similar over the entire period as between the ORBES region and the six-state area; their economic structures are almost identical at points in time or over time.

Tables 8 and 9 contain growth rates, by sector, as well as the percentage contribution of each sector to overall regional growth, 1960-1975. In Table 10, sectors are rank ordered in terms of their contribution to growth of regional gross product. These tables are based on calculations reported in Tables 2, 4, 5, and 6.

Over the period 1960-1975, the most rapidly growing ORBES sectors were government (3.43%), transportation-communication-utilities (3.43%), and finance-insurance-real estate (3.41%). These three sectors experienced significantly higher rates than the remaining sectors, the next closest rate being 2.80% for the trade sector. Sectors experiencing growth rates greater than the ORBES regional gross product rate (2.47%), are the above three plus trade (2.80%) and mining (2.49%).

There are a few striking differences in sectoral growth rates between the ORBES region and the six-state area. In particular, over the period 1960-1975, the government sector has grown more slowly in the six-state area than in the ORBES region (2.84% compared to 3.43%), while private nonfarm has grown more rapidly (2.88% compared to 2.41%). Within private nonfarm, the six-state area has experienced significantly high rates of growth in manufacturing (2.97% compared to 2.15%), finance-insurance-real estate (3.83% compared to 3.41%), and services and other (2.41% compared to 2.08%).

TABLE 8

AVERAGE ANNUAL COMPOUND GROWTH RATES BY INDUSTRY[1]

Industry	1960-1965			1965-1970			1970-1975			1960-1975		
	ORBES	Six States	U.S.	ORBES	Six States	U.S.	ORBES	Six States	U.S.	ORBES	Six States	U.S.
Government	1.55	2.59	3.51	5.29	3.50	3.59	3.48	2.42	1.32	3.43	2.84	2.80
Farm	2.75	2.88	.49	-4.93	-4.01	.78	6.26	4.92	1.91	1.25	1.19	1.06
Private Non-Farm	2.31	4.18	5.03	3.85	2.77	3.04	1.10	1.69	2.20	2.41	2.88	3.44
Mining	.70	1.89	2.63	4.84	2.84	3.10	1.96	2.27	-.42	2.49	2.33	1.76
Construction	.43	2.18	4.31	3.28	1.17	-.04	-4.49	-3.66	-2.70	-.31	-.13	.48
Manufacturing	2.92	5.82	6.45	3.06	2.33	2.08	0.50	0.84	.71	2.15	2.97	3.05
Trade	2.37	3.36	4.74	4.27	3.49	3.72	1.76	2.06	3.42	2.80	2.97	3.96
Finance, Insurance, Real Estate	3.29	5.01	4.55	5.00	3.58	3.76	1.95	2.92	3.23	3.41	3.83	3.85
Transportation, Communication, Utilities	3.15	4.26	5.08	1.62	1.57	5.06	5.57	4.80	3.23	3.43	3.53	4.45
Services and Other	.16	1.37	4.16	6.35	3.90	3.34	-0.12	1.96	3.69	2.08	2.41	3.73
TOTAL	2.26	3.98	4.67	3.61	2.66	3.04	1.54	1.84	2.07	2.47	2.82	3.26

1. ORBES region and six-state data taken from Tables 2, 4, 5, and 6. United States data taken from Statistical Abstract of the United States, 1976, Table 632, "Rates of Economic Growth: 1910-1975", p. 395. Real dollars are based on Table 1 implicit price deflators by industry. Compounded growth rates calculated using the formula:

$$i = (FV/PV)^{1/n} - 1.$$

TABLE 9

PERCENT CONTRIBUTION OF EACH INDUSTRY TO 1960-1975 GROWTH IN GROSS PRODUCT, BY REGION[1]

(1972 = 100)

(millions of dollars)

	ORBES		SIX STATES		UNITED STATES	
	Increase/Decrease	Percent	Increase/Decrease	Percent	Increase/Decrease	Percent
Government	5,573.7	15	9,033.1	10	55,100	12
Farm	863.3	02	1,066.7	01	5,500	01
Private Non-Farm	(31,020.7)	(83)	(76,026.8)	(88)	(394,100)	(87)
Mining	1,095.9	03	1,240.3	01	4,300	01
Construction	-238.8	-01	-202.7	00	3,400	01
Manufacturing	10,262.0	27	27,723.1	32	98,000	22
Trade	6,720.2	18	14,853.0	17	93,200	20
Finance, Insurance, Real Estate	5,414.7	14	14,159.2	16	77,900	17
Transportation, Communication, Utilities	4,471.8	12	9,702.4	11	53,500	12
Services and Other	3,294.9	09	8,551.5	10	63,800	14
TOTAL Change in Gross Product	37,457.7	100	86,126.6	100	454,700	100

1. Calculated from data in Tables 2 and 4.

TABLE 10

RANK ORDER OF INDUSTRY CONTRIBUTION TO 1960-1975 GROWTH IN GROSS PRODUCT, BY REGION[1]

(1972 = 100)

Rank	ORBES Industry	Percent	Rank	SIX STATES Industry	Percent	Rank	UNITED STATES Industry	Percent
1	Manufacturing	27	1	Manufacturing	32	1	Manufacturing	22
2	Trade	18	2	Trade	17	2	Trade	20
3	Government	15	3	Finance, Insurance, Real Estate	16	3	Finance, Insurance, Real Estate	17
4	Finance, Insurance, Real Estate	14	4	Transportation, Communication, Utilities	11	4	Services	14
5	Transportation, Communication, Utilities	12	5	Government	10	5	Government	12
6	Services	09	6	Services	10	6	Transportation, Communication, Utilities	12
7	Mining	03	7	Mining	01	7	Farm	01
8	Farm	02	8	Farm	01	8	Mining	01
9	Construction	-01	9	Construction	00	9	Construction	01

1. Calculated from data in Tables 2 and 4.

Given the very large percentage contribution of private non-farm to total six-state area growth (88% --see Table 9), higher rates within that sector account for a substantial amount of the difference in gross product growth rates between the six-state area and the ORBES region. As shown in Table 10, manufacturing is ranked first with regard to industry contribution to growth of gross product in both the ORBES region and the six-state area. However, the percentage contribution of manufacturing to gross product growth is 33% in the six states and only 27% in the ORBES region. As manufacturing is known to have multiplier values exceeding those of other sectors, the higher manufacturing growth rate in the six-state area relative to the ORBES region is an important determinant of their relative gross product growth rates.

The comparison of most interest for the ORBES project, however, is between the growth experience in the ORBES region and in the United States. This is true because the ORBES scenarios distinguish between ORBES-regional and United States gross product, both in the base period and for year 2000 scenarios. Further, differences in patterns of growth, by sector, between the ORBES region and the United States can be accommodated within the context of the demand model for generating richer (more interesting) and more plausible year 2000 scenarios.

There are very marked differences between the ORBES region and United States growth experiences. There is, of course, the obvious difference in the gross product growth rate (3.26% for the United States and 2.47% for the ORBES region). Of more concern, however, are the sectoral growth rates (Table 8). The United States has experienced higher growth rates in every sector but government, farm, and mining. Not only are the United States rates higher in these sectors, but the differences are dramatic: private non-farm (3.44% compared to 2.41%), manufacturing (3.05% compared to 2.15%), trade (3.96% compared to 2.80%), transportation-communication-utilities (4.45% compared to 3.43%), and services and other (3.73% compared to 2.08%). These differences are mirrored in Table 9, where we find that 87% of the growth in United States gross product is accounted for by private non-farm, while only 83% of ORBES regional growth is associated with private non-farm. Particularly significant with regard to energy utilization are the higher United States sectoral growth rates for manufacturing and transportation-communication-utilities.

The differences in sectoral growth rates between the ORBES region and the United States, then, can provide the basis for specifying particular distributions of year 2000 gross product across sectors in the ORBES energy and fuel demand study. The energy use implications for the ORBES scenarios should be significant given the relative sector growth rates between the United States and the ORBES region discussed above.

The calculations reported in Tables 9 and 10 provide some additional perspective on the nature of economic growth in the ORBES region, the six-state area, and the United States. Table 9 shows the percentage contribution of each sector to 1960-1975 growth in gross product for each region, and Table 10 rank orders those sectors. The information in Table 9 should not be confused with growth rates by sector. For instance, manufacturing

contributes 27% to total change in gross product in the ORBES region, compared to 22% for the United States. Despite this, the growth rate for manufacturing in the United States is 3.05%, compared to 2.15% for the ORBES region. The percentage contribution of manufacturing to the overall change in gross product is influenced, of course, by the absolute amount of the change in gross product and the relative changes in other sectors. Nonetheless, Tables 9 and 10 do provide a perspective not offered by comparing growth rates alone.

In terms of the percentage contribution to gross product change, 1960-1975, the rank order by sector is quite similar between the ORBES region and the six-state area except in the case of government, which is ranked third in the ORBES region and fifth in the six-state area. With respect to the percentage contribution by sector, however, manufacturing accounts for a substantially larger percentage of total gross product change in the six-state area (32% compared to 27%). While mining is ranked seventh in both cases, it contributes 3% to gross product change, 1960-1975, for the ORBES region but only 1% for the six-state area. Other percentage contributions are similar for the ORBES region and the six-state area, except, government, which contributed 15% in the former case and only 10% in the latter.

Some interesting differences are found between the ORBES region and United States rank orders as well as in the percentage values (see Table 10). Finance-insurance-real estate contributed 17% to the 1960-1975 change in United States gross product compared to 14% for the ORBES region. Services contributed 14% in the United States and only 9% in the ORBES region. Government contributed 15% in the ORBES region but only 12% in the United States. Mining (3%) and farm (2%) contributed more in the ORBES region than in the United States.

As was true of sectoral growth rates, there are substantial differences in the sectoral characteristics of the United States and the ORBES region that, given the information in this report, can be built into the ORBES regional demand model for fuels and energy.

SECTION 4

CONCLUSIONS

With respect to the use of this information in the ORBES project, the following conclusions are of most interest:

(1) ORBES-region economic activity in 1975 was approximately 48% of six-state activity ($122,295.9 compared to $252,341.2). To a considerable extent, the sharp difference in economic activity is accounted for by the exclusion from the region of major centers of economic activity in Illinois and Pennsylvania.

(2) While most sectors in the ORBES region constituted approximately 48% of six-state activity, the mining and agriculture contribution to six-state gross product is highly concentrated in the ORBES region (86% and 77%, respectively).

(3) With respect to the percentage contribution to 1975 gross product, by sector, the ORBES region, relative to the United States or the six-state experience, generates less in tertiary activities (trade, finance, and service).

(4) The average annual compounded percent increase of real product, 1960-1975, in the ORBES region has been substantially lower than in the six-state area or the United States (2.47% compared to 2.82% and 3.26%, respectively).

(5) The basic structure of the ORBES-region economy appears to have been relatively stable over the period 1960-1975. Some minor shifts in the structure were observed with respect to government and tertiary sectors. The ORBES-region economic structure is very similar to that of the six-state area.

(6) ORBES-region sectors experiencing growth rates greater than the 2.47% for regional gross product were government (3.43%), transportation-communication-utilities (3.43%), finance-insurance-real estate (3.41%), trade (2.80%), and mining (2.49%). The first three clearly represent high growth sectors over the 15-year period examined in this work. The major relative difference between the ORBES-region and the United States experience occurs with respect to the growth of the private non-farm sector.

(7) While the percentage contribution of most specified sectors to 1960-1975 growth in gross product was different as between the

ORBES region and the United States, major differences occurred in manufacturing (27% for the ORBES region, 22% for the United States) and services (9% for the ORBES region, 14% for the United States).

APPENDIX A

STATE SHARES AND ORBES-REGION SHARE TABLES, 1960-1975

Notes for Tables A-1 to A-24

1. Real product calculated using implicit price deflators (1972 = 100) by industry taken from The National Income and Product Accounts of the United States 1929-74, U.S. Department of Commerce, Bureau of Economic Analysis, U.S. Government Printing Office, Washington, D.C., and Survey of Current Business, July 1977, Table 7.15.

2. Employment data for 1960 and 1970 are available from the U.S. Department of Commerce, Bureau of the Census, Census of Population. The following employment groupings were used to estimate employment in each industry group by ORBES counties.

Sector	Census Category
Government	Services and other (see below)
Farm	Agriculture, forestry, and fisheries
Private non-farm	
Mining	Mining
Construction	Construction
Manufacturing	Manufacturing
Trade	Wholesale trade; food, bakery and dairy stores; eating and drinking places; general merchandise retailing; motor vehicle retailing and service stations; other retail trade
Finance, insurance, and real estate	Bank and credit agencies; insurance, real estate, and other finance
Transportation, communication, and utilities	Railroads and railway express services; trucking service and warehousing; other transportation; communications; utilities and sanitary services

Sector	Census Category
Services and Other	Business and repair services, private households; other personal services; entertainment and recreation services; hospitals; health services, except hospitals; elementary, secondary schools, and colleges--government; elementary, secondary schools--private; other education and kindred services; welfare, religious, and nonprofit membership organizations; legal, engineering, and miscellaneous professional services; public administration

Employment data for 1965 are taken from County Business Patterns, also published by the Bureau of the Census; 1975 employment data are taken from Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

3. ORBES portion calculated from percent employment in ORBES counties by sector compared to state totals. Factors also represent percentage, by industry, of ORBES portion of state total.

4. U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, published annually in the August issue.

5. U.S. Department of Agriculture, Economic Research Service, Farm Income Situation, published annually in the August issue. After 1974 the title is Farm Income Statistics.

6. U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, published annually in the July issue.

7. Price deflator for transportation-communication-utilities is a weighted average, by employment, of the implicit price deflators for the transportation-communications-utilities sector.

TABLE A-1

GROSS PRODUCT, 1960, FOR ILLINOIS
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Illinois Total	ORBES Factor	ORBES State Share*
Government	4,909.3	.28	1,374.6
Farm	1,920.4	.76	1,459.5
Private Non-Farm	(41,577.8)		(11,046.0)
Mining	439.0	.93	408.3
Construction	3,339.0	.32	1,068.5
Manufacturing	12,144.9	.23	2,793.3
Trade	8,626.8	.29	2,501.8
Finance, Insurance, Real Estate	6,448.9	.21	1,354.3
Transportation, Communication, Utilities	4,242.9	.27	1,145.6
Services and Other	6,336.3	.28	1,774.2
TOTAL GROSS PRODUCT	48,407.5		13,880.1

*ORBES share of total state product is 29%.

TABLE A-2

GROSS PRODUCT, 1960, FOR INDIANA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Indiana Total	ORBES Factor	ORBES State Share*
Government	1,831.0	.59	1,080.3
Farm	1,063.9	.87	925.6
Private Non-Farm	(15,996.8)		(11,489.1)
Mining	154.5	.90	139.1
Construction	1,154.7	.74	854.5
Manufacturing	6,625.2	.67	4,438.9
Trade	2,929.8	.77	2,255.9
Finance, Insurance, Real Estate	1,900.1	.86	1,634.1
Transportation, Communication, Utilities	1,441.2	.77	1,109.7
Services and Other	1,791.3	.59	1,056.9
TOTAL GROSS PRODUCT	18,891.7		13,495.0

*ORBES share of total state product is 71%.

TABLE A-3

GROSS PRODUCT, 1960, FOR KENTUCKY
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Kentucky Total	ORBES Factor	ORBES State Share*
Government	1,317.7	1.0	1,317.7
Farm	644.7	1.0	644.7
Private Non-Farm	(6,959.8)		(6,959.8)
Mining	402.2	1.0	402.2
Construction	542.7	1.0	542.7
Manufacturing	2,192.1	1.0	2,192.1
Trade	1,336.1	1.0	1,336.1
Finance, Insurance, Real Estate	843.4	1.0	843.4
Transportation, Communication, Utilities	737.1	1.0	737.1
Services and Other	906.2	1.0	906.2
TOTAL GROSS PRODUCT	8,922.2		8,922.2

*ORBES share of total state product is 100%.

TABLE A-4

GROSS PRODUCT, 1960, FOR OHIO
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Ohio Total	ORBES Factor	ORBES State Share*
Government	4,116.9	.70	2,881.8
Farm	1,027.3	.89	914.3
Private Non-Farm	(35,660.0)		(26,491.5)
Mining	326.2	.65	212.0
Construction	2,468.1	.70	1,727.7
Manufacturing	14,219.7	.87	12,371.1
Trade	6,466.0	.65	4,202.9
Finance, Insurance, Real Estate	4,197.5	.64	2,686.4
Transportation, Communication, Utilities	3,292.7	.61	2,008.5
Services and Other	4,689.8	.70	3,282.9
TOTAL GROSS PRODUCT	40,804.2		30,287.6

*ORBES share of total state product is 74%.

TABLE A-5

GROSS PRODUCT, 1960, FOR PENNSYLVANIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Pennsylvania Total	ORBES Factor	ORBES State Share*
Government	4,589.3	.28	1,285.0
Farm	707.9	.22	155.7
Private Non-Farm	(38,517.4)		(11,752.2)
Mining	902.7	.59	532.6
Construction	2,573.3	.30	772.0
Manufacturing	13,590.8	.30	4,077.2
Trade	6,922.2	.31	2,145.9
Finance, Insurance, Real Estate	4,865.6	.28	1,362.4
Transportation, Communication, Utilities	3,910.8	.32	1,251.5
Services and Other	5,752.0	.28	1,610.6
TOTAL GROSS PRODUCT	43,814.6		13,192.9

*ORBES share of total state product is 30%.

TABLE A-6

GROSS PRODUCT, 1960, FOR WEST VIRGINIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	West Virginia Total	ORBES Factor	ORBES State Share*
Government	557.1	.94	523.7
Farm	123.6	.86	106.3
Private Non-Farm	(4,692.4)		(4,429.7)
Mining	775.5	.99	767.7
Construction	253.9	.92	233.6
Manufacturing	1,466.4	.93	1,363.8
Trade	706.1	.95	670.8
Finance, Insurance, Real Estate	427.9	.95	406.5
Transportation, Communication, Utilities	574.6	.92	528.6
Services and Other	488.0	.94	458.7
TOTAL GROSS PRODUCT	5,373.1		5,059.7

*ORBES share of total state product is 94%.

TABLE A-7

GROSS PRODUCT, 1965, FOR ILLINOIS
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Illinois Total	ORBES Factor	ORBES State Share*
Government	5,581.9	.19	1,060.6
Farm	2,513.7	.75	1,885.3
Private Non-Farm	(52,420.9)		(10,736.4)
Mining	558.4	.61	340.6
Construction	3,402.5	.24	816.6
Manufacturing	17,560.5	.20	3,512.1
Trade	10,310.5	.22	2,268.3
Finance, Insurance, Real Estate	8,379.4	.17	1,424.5
Transportation, Communication, Utilities	5,448.2	.20	1,089.6
Services and Other	6,761.4	.19	1,284.7
TOTAL GROSS PRODUCT	60,516.5		13,682.3

*ORBES share of total state product is 22%.

TABLE A-8

GROSS PRODUCT, 1965, FOR INDIANA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Indiana Total	ORBES Factor	ORBES State Share*
Government	2,264.8	.73	1,653.3
Farm	1,307.3	.88	1,150.4
Private Non-Farm	(20,701.3)		(15,188.0)
Mining	170.2	.76	129.4
Construction	1,469.3	.66	969.7
Manufacturing	9,275.9	.72	6,678.7
Trade	3,459.9	.75	2,594.9
Finance, Insurance, Real Estate	2,489.4	.78	1,941.7
Transportation, Communication, Utilities	1,823.3	.77	1,403.9
Services and Other	2,013.3	.73	1,469.7
TOTAL GROSS PRODUCT	24,273.4		17,991.7

*ORBES share of total state product is 74%.

TABLE A-9

GROSS PRODUCT, 1965, FOR KENTUCKY
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Kentucky Total	ORBES Factor	ORBES State Share*
Government	1,527.4	1.0	1,527.4
Farm	746.4	1.0	746.4
Private Non-Farm	(9,440.4)		(9,440.4)
Mining	429.9	1.0	429.9
Construction	720.0	1.0	720.0
Manufacturing	3,384.4	1.0	3,384.4
Trade	1,688.4	1.0	1,688.4
Finance, Insurance, Real Estate	1,122.5	1.0	1,122.5
Transportation, Communication, Utilities	959.0	1.0	959.0
Services and Other	1,136.2	1.0	1,136.2
TOTAL GROSS PRODUCT	11,714.2		11,714.2

*ORBES share of total state product is 100%.

TABLE A-10

GROSS PRODUCT, 1965, FOR OHIO
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Ohio Total	ORBES Factor	ORBES State Share*
Government	4,704.5	.61	2,869.7
Farm	995.8	.82	816.6
Private Non-Farm	(42,373.8)		(27,105.8)
Mining	403.7	.75	302.8
Construction	2,756.7	.63	1,736.7
Manufacturing	17,693.5	.64	11,323.8
Trade	7,498.8	.68	5,099.2
Finance, Insurance, Real Estate	5,165.7	.62	3,202.7
Transportation, Communication, Utilities	3,883.4	.62	2,407.7
Services and Other	4,972.0	.61	3,032.9
TOTAL GROSS PRODUCT	48,074.1		30,792.1

*ORBES share of total state product is 64%.

TABLE A-11

GROSS PRODUCT, 1965, FOR PENNSYLVANIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Pennsylvania Total	ORBES Factor	ORBES State Share*
Government	4,930.4	.29	1,429.8
Farm	671.2	.22	147.7
Private Non-Farm	(45,261.4)		(13,033.4)
Mining	836.1	.58	484.9
Construction	2,837.2	.28	794.4
Manufacturing	16,705.6	.28	4,677.6
Trade	8,075.4	.29	2,341.9
Finance, Insurance, Real Estate	6,212.4	.26	1,615.2
Transportation, Communication, Utilities	4,698.8	.30	1,409.6
Services and Other	5,895.9	.29	1,709.8
TOTAL GROSS PRODUCT	50,863.0		14,610.9

*ORBES share of total state product is 29%.

TABLE A-12

GROSS PRODUCT, 1965, FOR WEST VIRGINIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	West Virginia Total	ORBES Factor	ORBES State Share*
Government	675.4	.89	601.1
Farm	90.7	.78	70.7
Private Non-Farm	(5,822.6)		(5,580.4)
Mining	896.3	.96	860.5
Construction	326.0	.84	273.8
Manufacturing	2,042.5	.92	1,879.1
Trade	801.3	.94	753.2
Finance, Insurance, Real Estate	481.9	.91	438.5
Transportation, Communication, Utilities	680.8	.95	646.8
Services and Other	593.8	.89	528.5
TOTAL GROSS PRODUCT	6,588.7		6,052.2

*ORBES share of total state product is 92%.

TABLE A-13

GROSS PRODUCT, 1970, FOR ILLINOIS
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Illinois Total	ORBES Factor	ORBES State Share*
Government	6,713.0	.29	1,946.8
Farm	1,544.9	.73	1,127.8
Private Non-Farm	(59,890.1)		(15,716.4)
Mining	569.7	.82	467.2
Construction	3,617.5	.33	1,193.8
Manufacturing	19,508.6	.24	4,682.1
Trade	12,052.7	.27	3,254.2
Finance, Insurance, Real Estate	9,889.7	.22	2,175.7
Transportation, Communication, Utilities	6,309.5	.26	1,640.1
Services and Other	7,942.4	.29	2,303.3
TOTAL GROSS PRODUCT	68,148.0		18,791.0

*ORBES share of total state product is 28%.

TABLE A-14

GROSS PRODUCT, 1970, FOR INDIANA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Indiana Total	ORBES Factor	ORBES State Share*
Government	2,472.6	.80	1,978.1
Farm	1,028.3	.88	904.9
Private Non-Farm	(21,967.1)		(16,802.7)
Mining	174.5	.94	164.0
Construction	1,428.0	.78	1,113.9
Manufacturing	10,221.1	.74	7,563.6
Trade	4,096.2	.78	3,195.0
Finance, Insurance, Real Estate	2,982.4	.78	2,326.2
Transportation, Communication, Utilities	592.9	.78	462.4
Services and Other	2,472.0	.80	1,977.6
TOTAL GROSS PRODUCT	25,468.0		19,685.7

*ORBES share of total state product is 77%.

TABLE A-15

GROSS PRODUCT, 1970, FOR KENTUCKY
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Kentucky Total	ORBES Factor	ORBES State Share*
Government	1,824.9	1.0	1,824.9
Farm	777.8	1.0	777.8
Private Non-Farm	(11,528.7)		(11,528.7)
Mining	580.0	1.0	580.0
Construction	751.3	1.0	751.3
Manufacturing	4,251.0	1.0	4,251.0
Trade	2,067.4	1.0	2,067.4
Finance, Insurance, Real Estate	1,350.7	1.0	1,350.7
Transportation, Communication, Utilities	1,149.6	1.0	1,149.6
Services and Other	1,378.7	1.0	1,378.7
TOTAL GROSS PRODUCT	14,131.4		14,131.4

*ORBES share of total state product is 100%.

TABLE A-16

GROSS PRODUCT, 1970, FOR OHIO
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Ohio Total	ORBES Factor	ORBES State Share*
Government	5,444.8	.67	3,648.0
Farm	945.0	.75	708.8
Private Non-Farm	(49,692.0)		(32,783.4)
Mining	517.2	.80	413.7
Construction	2,807.8	.68	1,909.3
Manufacturing	20,046.3	.66	13,230.6
Trade	9,119.1	.66	6,018.6
Finance, Insurance, Real Estate	6,286.4	.65	4,086.1
Transportation, Communication, Utilities	4,702.0	.63	2,962.3
Services and Other	6,213.2	.67	4,162.8
TOTAL GROSS PRODUCT	56,081.8		37,140.2

*ORBES share of total state product is 66%.

TABLE A-17

GROSS PRODUCT, 1970, FOR PENNSYLVANIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Pennsylvania Total	ORBES Factor	ORBES State Share*
Government	6,169.2	.28	1,727.4
Farm	774.8	.21	162.7
Private Non-Farm	(52,361.7)		(14,962.9)
Mining	874.3	.63	550.8
Construction	3,176.2	.28	889.3
Manufacturing	18,784.3	.27	5,071.8
Trade	9,517.0	.29	2,759.9
Finance, Insurance, Real Estate	7,396.8	.27	1,997.1
Transportation, Communication, Utilities	5,409.9	.31	1,677.1
Services and Other	7,203.2	.28	2,016.9
TOTAL GROSS PRODUCT	59,305.7		16,853.0

*ORBES share of total state product is 28%.

TABLE A-18

GROSS PRODUCT, 1970, FOR WEST VIRGINIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	West Virginia Total	ORBES Factor	ORBES State Share*
Government	758.3	.93	705.2
Farm	85.1	.71	60.4
Private Non-Farm	(6,357.9)		(5,906.3)
Mining	1,074.2	.98	1,052.7
Construction	422.9	.91	384.9
Manufacturing	1,970.8	.90	1,773.7
Trade	938.3	.94	882.0
Finance, Insurance, Real Estate	534.9	.94	502.8
Transportation, Communication, Utilities	747.5	.92	687.7
Services and Other	669.3	.93	622.5
TOTAL GROSS PRODUCT	7,201.3		6,671.9

*ORBES share of total state product is 93%.

TABLE A-19

GROSS PRODUCT, 1975, FOR ILLINOIS
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Illinois Total	ORBES Factor	ORBES State Share*
Government	7,671.2	.36	2,761.6
Farm	2,518.8	.80	2,015.0
Private Non-Farm	(63,938.3)		(14,105.1)
Mining	505.9	.71	359.2
Construction	2,906.4	.28	813.8
Manufacturing	20,099.6	.22	4,421.9
Trade	12,970.3	.24	3,112.9
Finance, Insurance, Real Estate	11,510.7	.18	2,071.9
Transportation, Communication, Utilities	7,393.3	.23	1,700.5
Services and Other	8,552.1	.19	1,624.9
TOTAL GROSS PRODUCT	74,128.3		18,881.7

*ORBES share of total state product is 25%.

TABLE A-20

GROSS PRODUCT, 1975, FOR INDIANA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Indiana Total	ORBES Factor	ORBES State Share*
Government	2,701.9	.83	2,242.6
Farm	1,393.8	.88	1,226.5
Private Non-Farm	(25,200.7)		(18,694.5)
Mining	147.9	.66	97.6
Construction	1,175.1	.71	834.3
Manufacturing	10,764.3	.71	7,642.7
Trade	4,534.3	.77	3,491.4
Finance, Insurance, Real Estate	3,436.2	.80	2,749.0
Transportation, Communication, Utilities	2,460.0	.77	1,894.2
Services and Other	2,682.9	.74	1,985.3
TOTAL GROSS PRODUCT	29,296.4		22,163.6

*ORBES share of total state product is 76%.

TABLE A-21

GROSS PRODUCT, 1975, FOR KENTUCKY
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Kentucky Total	ORBES Factor	ORBES State Share*
Government	2,047.9	1.0	2,047.9
Farm	705.6	1.0	705.6
Private Non-Farm	(13,462.7)		(13,462.7)
Mining	924.2	1.0	924.2
Construction	659.2	1.0	659.2
Manufacturing	4,782.3	1.0	4,782.3
Trade	2,479.8	1.0	2,479.8
Finance, Insurance, Real Estate	1,600.8	1.0	1,600.8
Transportation, Communication, Utilities	1,437.2	1.0	1,437.2
Services and Other	1,579.2	1.0	1,579.2
TOTAL GROSS PRODUCT	16,216.2		16,216.2

*ORBES share of total state product is 100%.

TABLE A-22

GROSS PRODUCT, 1975, FOR OHIO
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Ohio Total	ORBES Factor	ORBES State Share*
Government	6,006.3	.71	4,264.5
Farm	1,204.9	.75	903.7
Private Non-Farm	(52,924.9)		(33,861.2)
Mining	505.9	.67	339.0
Construction	2,299.2	.66	1,517.5
Manufacturing	21,025.4	.64	13,456.3
Trade	10,017.8	.65	6,511.6
Finance, Insurance, Real Estate	6,975.5	.65	4,534.1
Transportation, Communication, Utilities	5,371.9	.62	3,330.6
Services and Other	6,729.2	.62	4,172.1
TOTAL GROSS PRODUCT	60,136.1		39,029.4

*ORBES share of total state product is 65%.

TABLE A-23

GROSS PRODUCT, 1975, FOR PENNSYLVANIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	Pennsylvania Total	ORBES Factor	ORBES State Share*
Government	7,048.0	.27	1,903.0
Farm	665.2	.25	166.3
Private Non-Farm	(56,626.0)		(16,258.1)
Mining	996.7	.75	747.5
Construction	2,691.0	.29	780.4
Manufacturing	19,225.2	.27	5,190.8
Trade	10,599.2	.29	3,073.8
Finance, Insurance, Real Estate	8,625.9	.25	2,156.5
Transportation, Communication, Utilities	6,313.9	.32	2,020.4
Services and Other	8,174.1	.28	2,288.7
TOTAL GROSS PRODUCT	64,339.2		18,327.4

*ORBES share of total state product is 28%.

TABLE A-24

GROSS PRODUCT, 1975, FOR WEST VIRGINIA
AND ORBES STATE SHARE, BY INDUSTRY

(1972 = 100)

(millions of dollars)

Industry	West Virginia Total	ORBES Factor	ORBES State Share*
Government	879.1	.93	817.6
Farm	66.4	.79	52.5
Private Non-Farm	(7,281.1)		(6,807.9)
Mining	1,159.8	.94	1,090.2
Construction	399.3	.89	355.4
Manufacturing	2,066.1	.97	2,004.1
Trade	1,238.6	.94	1,164.3
Finance, Insurance, Real Estate	693.6	.85	589.6
Transportation, Communication, Utilities	925.4	.94	869.9
Services and Other	798.3	.92	734.4
TOTAL GROSS PRODUCT	8,226.6		7,678.0

*ORBES share of total state product is 93%.

APPENDIX B

STATE SHARES AND ORBES-REGION SHARE FIGURES
1975

FIGURE B-1

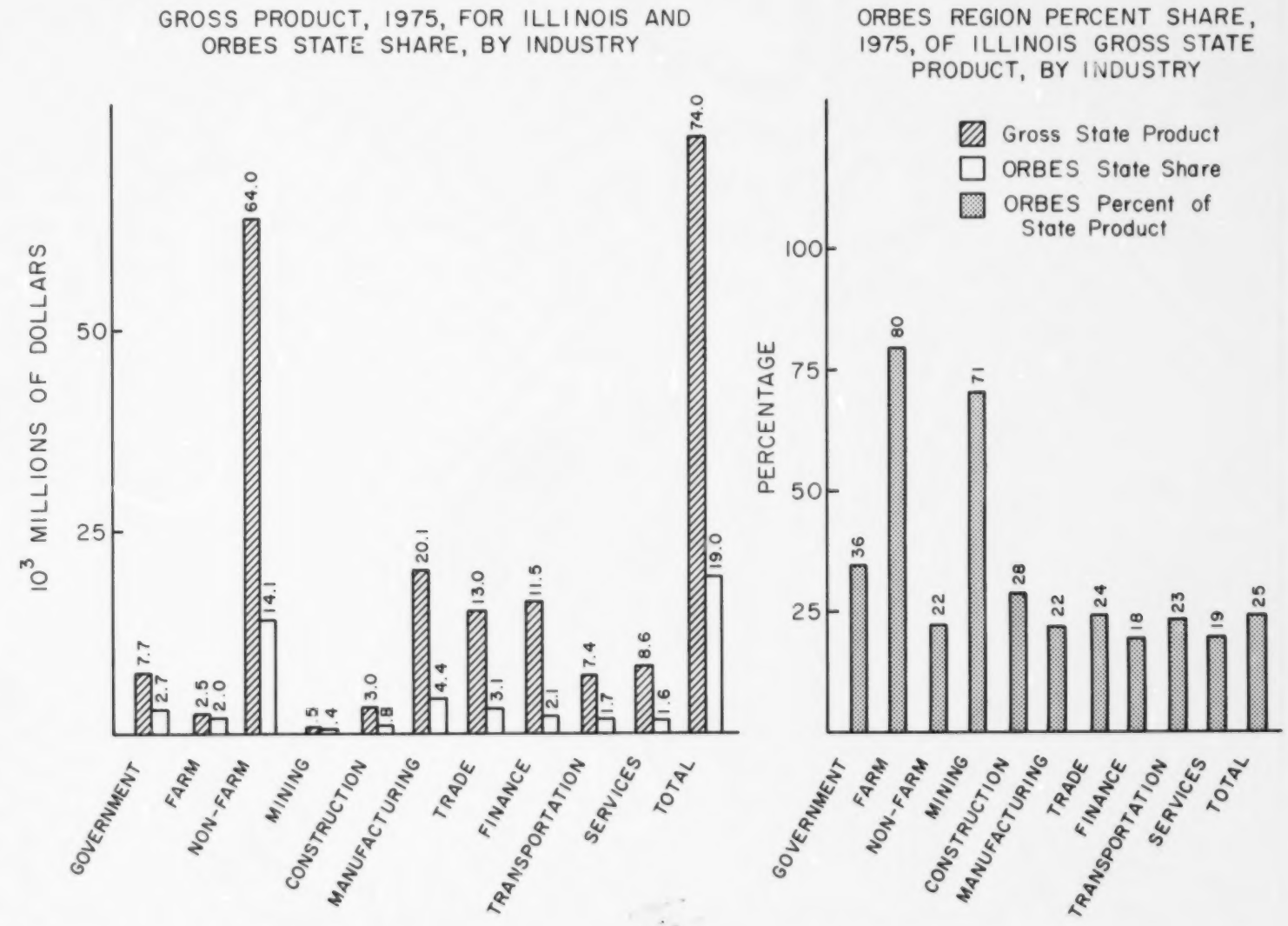
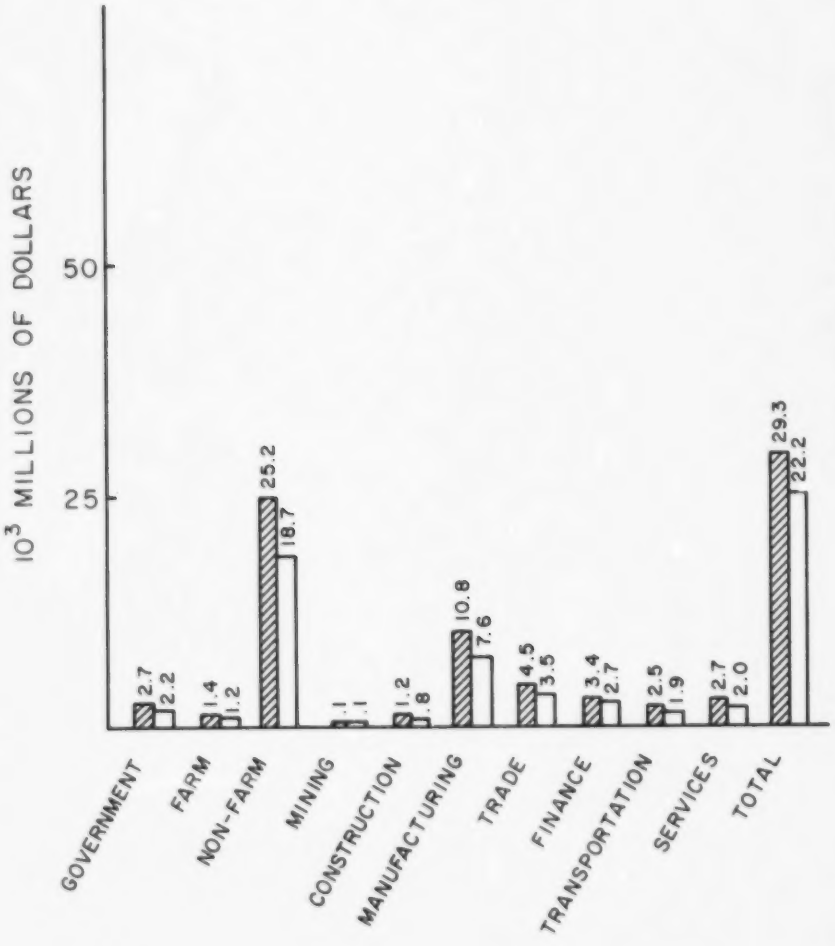

GROSS PRODUCT, 1975, FOR ILLINOIS AND ORBES STATE SHARE, BY INDUSTRY
10^3 MILLIONS OF DOLLARS
50
25
7.7
2.7
2.5
2.0
64.0
14.1
.5
.4
3.0
.8
20.1
4.4
13.0
3.1
11.5
2.1
7.4
1.7
8.6
1.6
74.0
19.0
GOVERNMENT
FARM
NON-FARM
MINING
CONSTRUCTION
MANUFACTURING
TRADE
FINANCE
TRANSPORTATION
SERVICES
TOTAL
ORBES REGION PERCENT SHARE, 1975, OF ILLINOIS GROSS STATE PRODUCT, BY INDUSTRY
Gross State Product
ORBES State Share
ORBES Percent of State Product
PERCENTAGE
100
75
50
25
36
80
22
71
28
22
24
18
23
19
25
GOVERNMENT
FARM
NON-FARM
MINING
CONSTRUCTION
MANUFACTURING
TRADE
FINANCE
TRANSPORTATION
SERVICES
TOTAL

FIGURE B-2

GROSS PRODUCT, 1975, FOR INDIANA AND ORBES STATE SHARE, BY INDUSTRY



ORBES REGION PERCENT SHARE, 1975, OF INDIANA GROSS STATE PRODUCT, BY INDUSTRY

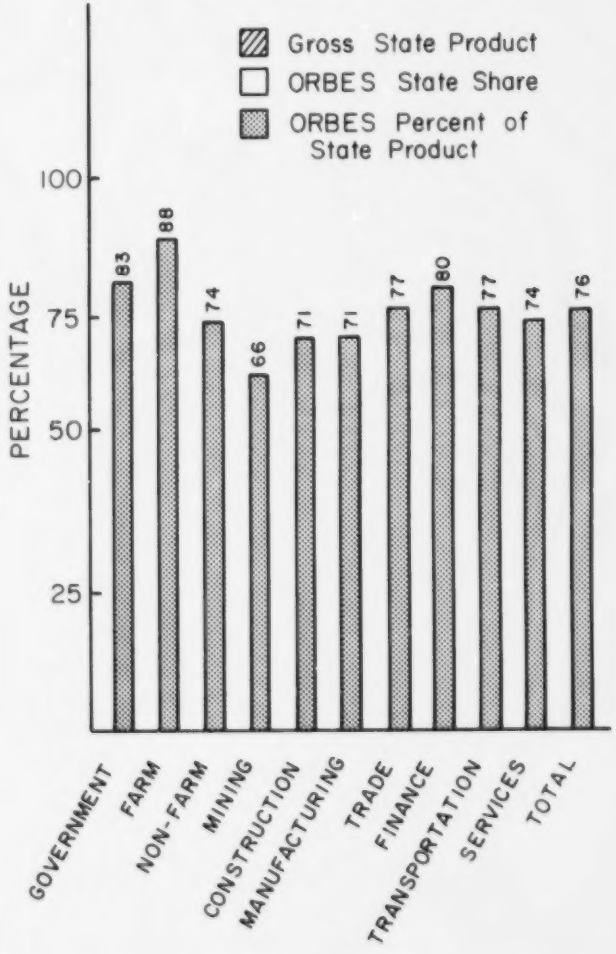


FIGURE B-3

GROSS PRODUCT, 1975, FOR KENTUCKY AND ORBES STATE SHARE, BY INDUSTRY

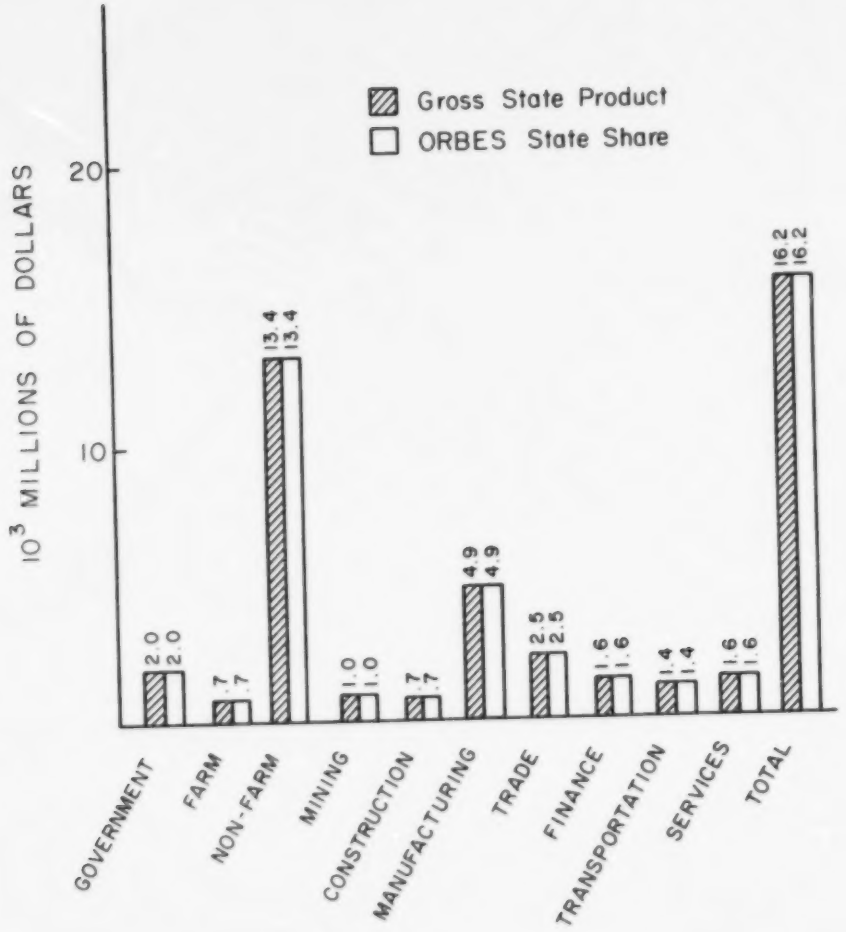


FIGURE B-4

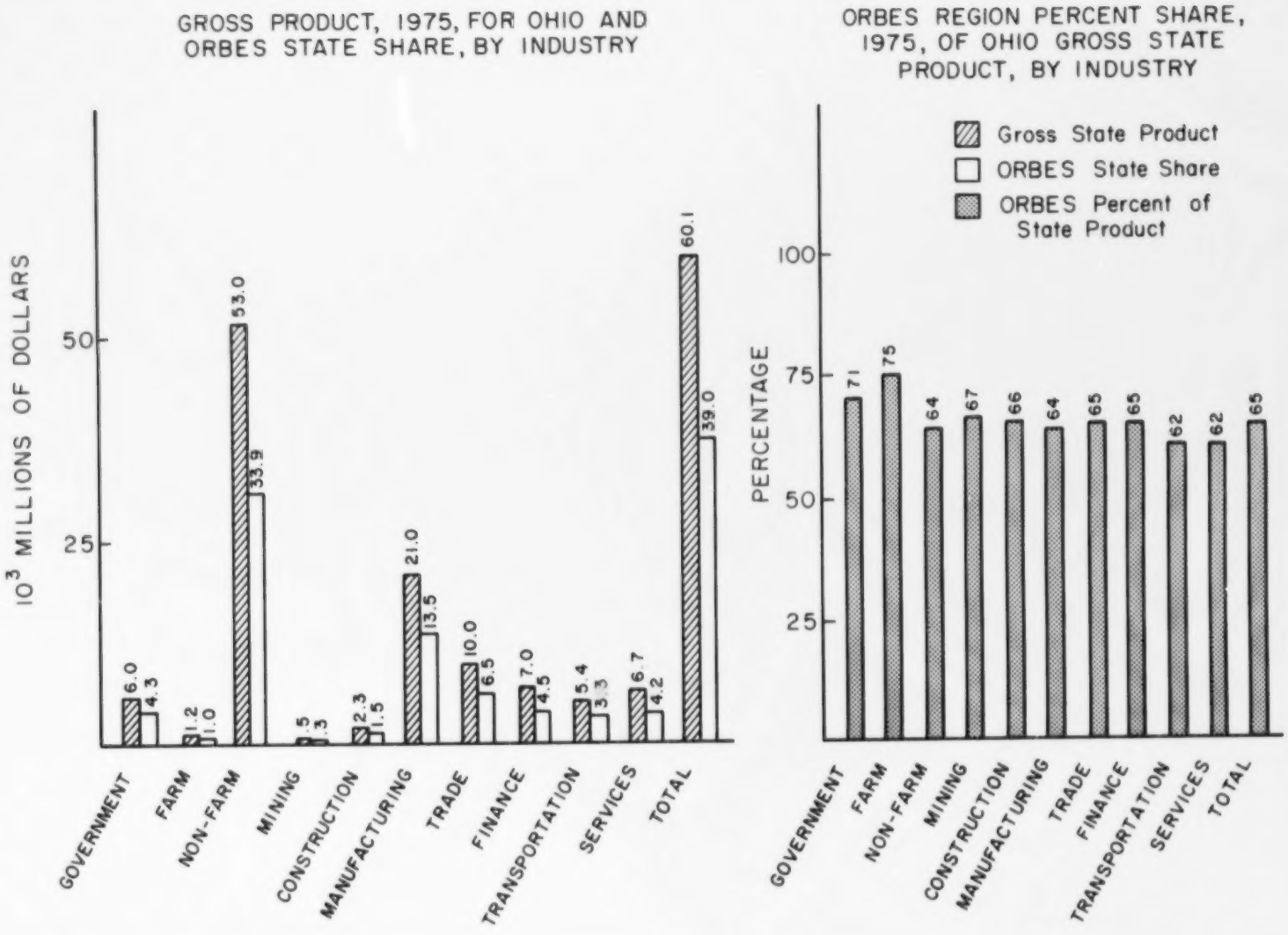
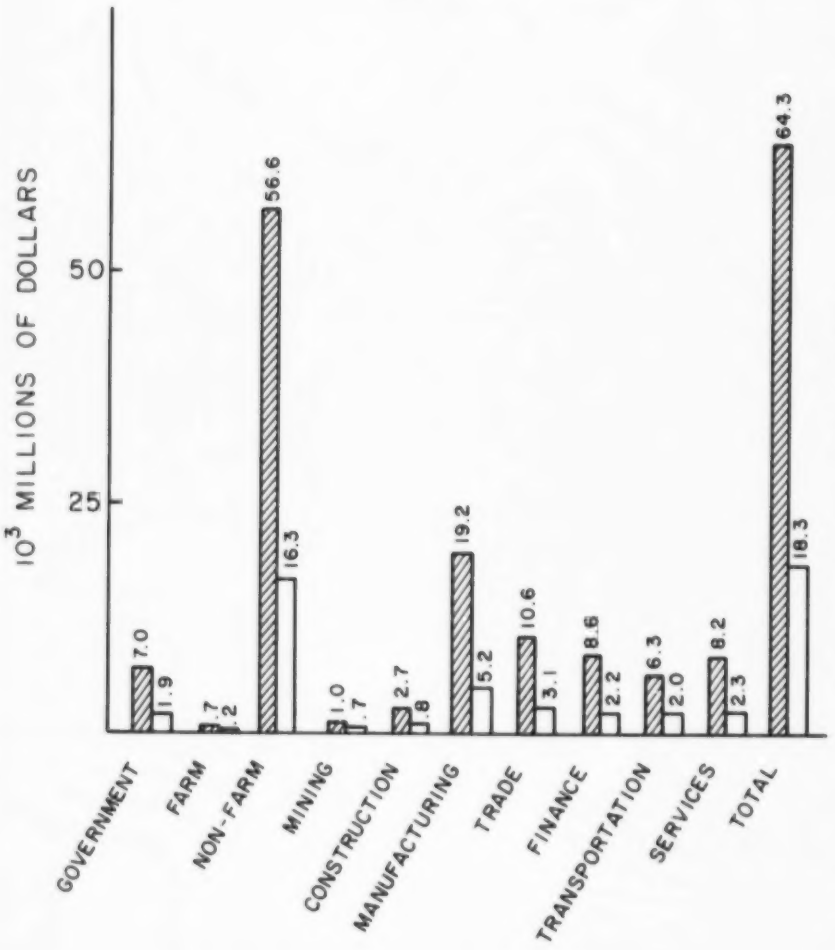

GROSS PRODUCT, 1975, FOR OHIO AND ORBES STATE SHARE, BY INDUSTRY
10^3 MILLIONS OF DOLLARS
50
25
6.0
4.3
1.2
1.0
53.0
33.9
.5
.3
2.3
1.5
21.0
13.5
10.0
6.5
7.0
4.5
5.4
3.3
6.7
4.2
60.1
39.0
GOVERNMENT
FARM
NON-FARM
MINING
CONSTRUCTION
MANUFACTURING
TRADE
FINANCE
TRANSPORTATION
SERVICES
TOTAL
ORBES REGION PERCENT SHARE, 1975, OF OHIO GROSS STATE PRODUCT, BY INDUSTRY
Gross State Product
ORBES State Share
ORBES Percent of State Product
PERCENTAGE
100
75
50
25
71
75
64
67
66
64
65
65
62
62
65
GOVERNMENT
FARM
NON-FARM
MINING
CONSTRUCTION
MANUFACTURING
TRADE
FINANCE
TRANSPORTATION
SERVICES
TOTAL

FIGURE B-5

GROSS PRODUCT, 1975, FOR PENNSYLVANIA AND ORBES STATE SHARE, BY INDUSTRY



ORBES REGION PERCENT SHARE, 1975, OF PENNSYLVANIA GROSS STATE PRODUCT, BY INDUSTRY

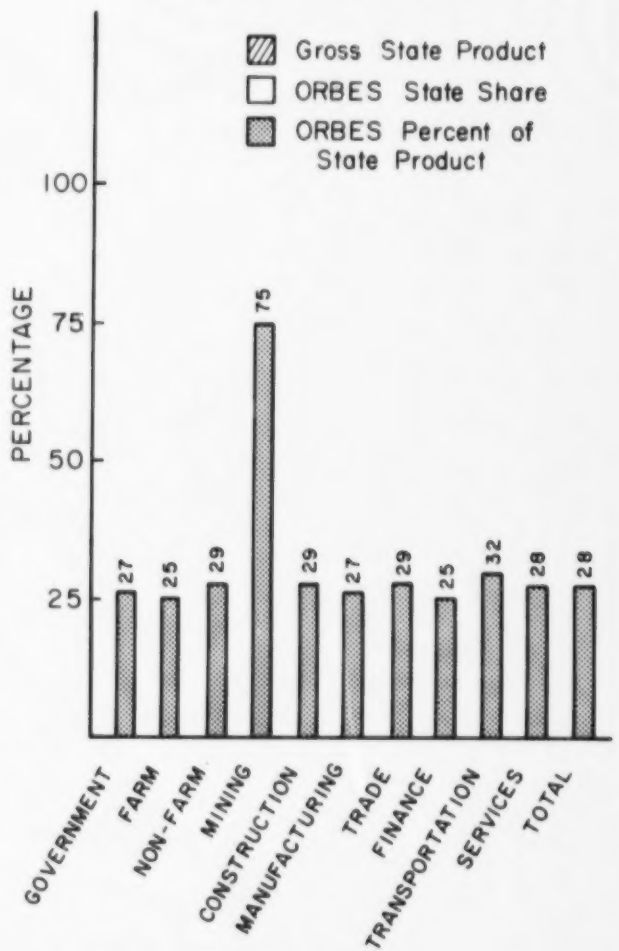
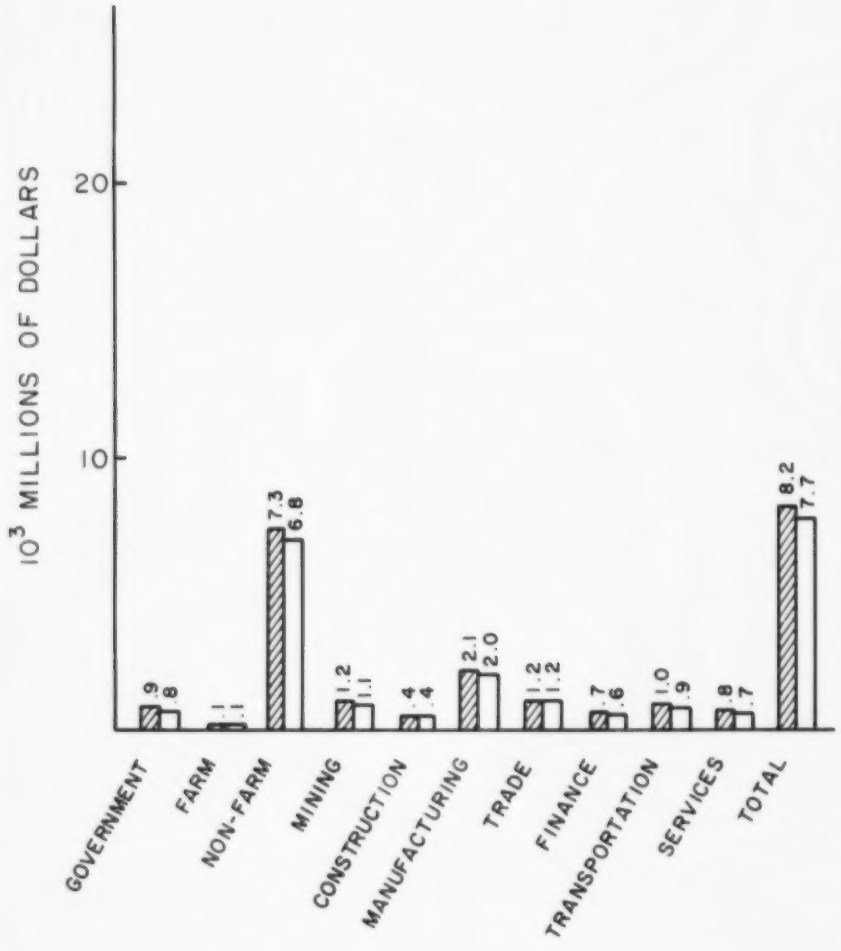
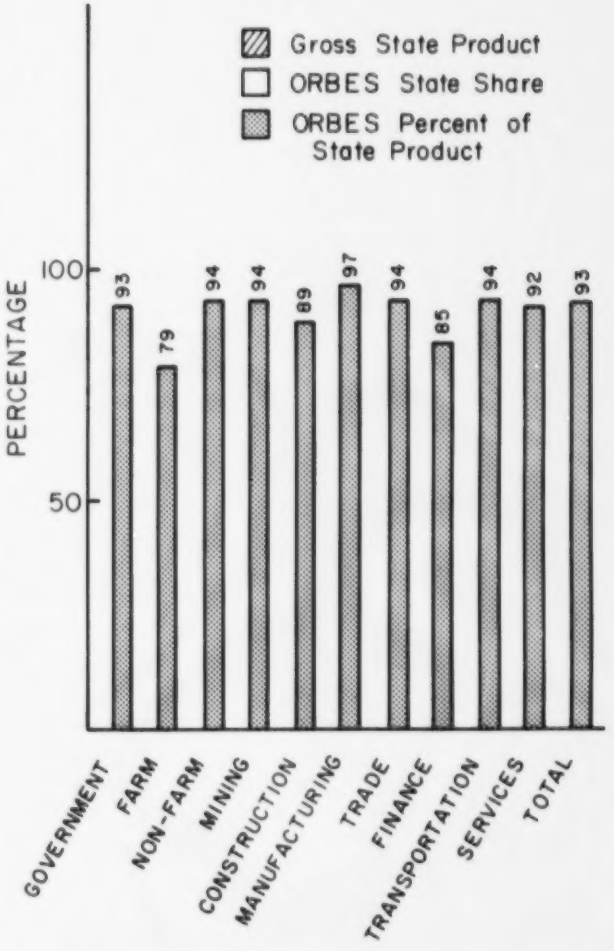


FIGURE B-6

GROSS PRODUCT, 1975, FOR WEST VIRGINIA AND ORBES STATE SHARE, BY INDUSTRY



ORBES REGION PERCENT SHARE, 1975, OF WEST VIRGINIA GROSS STATE PRODUCT, BY INDUSTRY



APPENDIX C

CALCULATION OF GROSS REGIONAL PRODUCT FOR THE ORBES REGION

A persistent problem in the field of regional economics is the lack of comprehensive data at the state or regional level. The only readily available measure of economic activity at the regional level is the U.S. Department of Commerce estimate of personal income.[1] While personal income estimates are useful for certain types of economic studies, they can be misleading when used to evaluate an area's overall economic performance. Ratajczak and Williams,[2] in arguing for more comprehensive data collection and estimation at the national level, list the shortcomings of currently used measures of state economic activity:

(1) Total employment data. While useful and valuable for some types of regional analysis, total employment follows a different pattern from total output. Total employment varies in composition both between regions and over time. Also, labor is only one factor of production, and its measurement can give only a partial picture of an area's economy.

(2) Personal income. Personal income data are also important in regional analysis. However, personal income is not total income. Current data suggest that there are persistent cyclical and regional differences in the ratio of total product to personal income. For a reasonable evaluation of an area's overall economic performance, a broad measure of economic activity is needed.

According to Albert Niemi, "Gross state product is the only measure that adequately reflects a state's or region's aggregate production, and, therefore, it is an essential measure for studying economic growth at the state or regional level."[3] Gross state or regional product is defined as the total economic activity originating in a given region. The basic framework is similar to that of the gross domestic product. The difference between gross domestic product and gross national product is that in the case of the latter, an adjustment in the calculations is made by subtracting net income from abroad. In the case of gross domestic product, no such adjustment is made. Similarly, gross regional product is the sum of output originating in the area in question regardless of the residence of the labor, capital, and other factors. It is generally agreed that gross domestic product is more appropriate for impact studies, economic base studies, state economic growth models, and other such studies where a measure of regional production is required.[4]

Gross state product calculations are not available in the standard U.S. Census and Department of Commerce inventories of economic activity and must be calculated by a long and tedious procedure. Since the mid-1960s, a number of researchers have developed methods for calculating gross state product. The method used here is that formulated by Kendrick and Jaycox[5] and modified by L'Esperance[6] and Niemi.[7] Other methods have been outlined by Romans,[8] Polensky et al.,[9] and Scheppach.[10]

The relative merits of the Kendrick-Jaycox, Romans, and Polenske methods were examined by L'Esperance, Baird, and Shumay.[11] The Kendrick-Jaycox method is based on data readily available from federal government sources. The method is largely based upon a determination of value added by industry. A detailed description of the Kendrick-Jaycox method is given below.

Romans' method for calculating gross state product involves the estimation of gross state expenditures, which is equal to gross domestic spending plus net exports. In his calculations Romans used the following identity:

GSY (Gross State Income) = GSE (Gross State Expenditures)

$$C + S + TN = C + I + G + X$$

so

$$X = S + Tn - (I + G)$$

C = personal consumption expenditures
I = gross private domestic investment
X = net exports on current accounts
G = government purchases
S = gross savings (personal plus business saving)
Tn = taxes net of government transfer payments to persons of interest paid by government

State estimates were compiled by Romans for S, tn, I, and G. Consumption was estimated by subtracting personal saving from estimates of personal disposable income (available from the U.S. Department of Commerce).

Polenske et al. estimated gross product by state by allocating a portion of gross national product to each state. They used an 80-industry input-output table to estimate state final demands. Final demands by industry were calculated for personal consumption expenditures, gross private capital formation, net inventory change, net exports by state of production, net exports by state, net purchases by state and local governments and net purchases by the federal government. United States net exports were allocated to the states. Net exports among the states were not taken into account.

In their comparisons of Polenske et al., Romans', and Kendrick and Jaycox's methods of calculating gross product, L'Esperance et al. concluded that "no categorical answer can be given at this time" as to the relative merits of the different procedures. They did conclude that if a time series is desired (as it is in this study), then the Kendrick-Jaycox method has the important advantage of using existing time series data that has been consistently estimated and reported for all states.[12]

The Kendrick and Jaycox[13] method is the most widely used method for calculating gross regional product, which also allows gross state product to be calculated. Further modifications and assumptions are then necessary to estimate gross product at the substate level. The Kendrick-Jaycox approach involves the estimation of value added for the following major economic sectors:

Government
Farm
Private non-Farm
  Mining
  Construction
  Manufacturing
  Trade
  Finance, insurance, and real estate
  Transportation, communication, and utilities
  Services and other

Gross product originating in each major industry category is estimated separately. The following is a description of the procedure involved in calculating gross product by sector for the state of Pennsylvania.

Government

Gross government product is defined as the compensation of general government employees, which is comprised of wages and salaries plus supplements. The wage and salary portion is available by SMSA in the U.S. Department of Commerce's personal income series. The supplement portion is not available on a sub-national basis and must be estimated from national data. This is done by multiplying the regional wage and salary figure by the national ratio of supplements to wages and salaries for each year.[14] For a given year, the procedure is as follows:

$$(S/WS)_n \cdot (WS)_s = S_s$$

$$(WS)_s + S_s = GGP_s$$

S = supplements
WS = wages and salaries
GGP = gross government product
n = nation
s = state

For Pennsylvania in 1970, gross government product is calculated as follows (millions of dollars):

Pennsylvania wages and salaries $(WS)_s = 4743$

National Ratio $(S/WS)_n = 10708/103646 = .103$

State Supplement to wages and salaries $= (WS)_s \cdot (S/WS)_n = 488.5$

$$GGP_s = S_s + (WS)_s = 5231.5$$

Farm

Data needed to calculate state gross farm product are available in the annual supplement to the August issue of Farm Income Situation (after 1974, Farm Income Statistics), published by the U.S. Department of Agriculture. Following is a calculation of the gross farm product of Pennsylvania for 1970 (in millions of dollars):[15]

Value of total farm output

(1)	Cash receipts from marketing	1040.1
(2)	Value of home consumption	27.5
(3)	Gross rental value of dwellings	129.6
(4)	Net rent to non-farm landlords	2.9
(5)	Net change in inventories	6.3
(6)	Total 1 + 2 + 3 - 4 + 5	1200.6

Intermediate Production Expenses

(7)	Feed	235.9
(8)	Livestock	39.6
(9)	Seed	19.0
(10)	Fertilizer	36.1
(11)	Repair and operation of equipment	121.4
(12)	Miscellaneous operating expenses	103.2
(13)	Total 7 + 8 + 9 + 10 + 11 + 12	555.2

Gross farm product (6 - 13) 645.4

Private Non-Farm

Calculating gross state product for industries in the private non-farm sector involves applying national coefficients to available state data. The national coefficients can be calculated from the U.S. Department of Commerce estimates of gross national product by major industry.[16] The basis for calculating gross state product for the non-farm sector is income received by persons for participation in current production. This income includes wage and salary disbursements, other labor income, and proprietors' income.

State income originating by industry is calculated by using the national ratio of income originating to income received. The same procedure is used to estimate capital consumption allowances and indirect business taxes for each industry.[17] The following formulas describe these calculations:[18]

$$YO_n^i \,/\, YR_n^i \;.\; YR_s^i = YO_s^i$$

$$KC_n^i \,/\, YO_n^i \;.\; YO_s^i = KC_s^i$$

$$IBT_n^i \,/\, YO_n^i \;.\; YO_s^i = IBT_s^i$$

YO = income originating
YR = income received
KC = capital consumption allowances
IBT = indirect business taxes
i = industry i
n = nation
s = state

The sum of these three components yields gross product originating in industry i for the particular state:

$$YO_s^i + KC_s^i + IBT_s^i = GPO_s^i$$

A sample worksheet for estimating private non-farm state product in Pennsylvania is presented on the following page.

Following Neimi, the estimate of gross product originating in manufacturing is adjusted to eliminate any bias introduced by the assumption of similar factor proportions.[19] The adjustment factor is calculated from state manufacturing value added and labor payroll data, published by the U.S. Department of Commerce in the Annual Survey of Manufactures. Value added per dollar of labor payroll in the state is compared to value added per dollar of labor payroll in the nation:

$$VA_s/LP_s \;/\; VA_n/LP_n$$

Multiplying this by the unadjusted estimate of gross state product originating in manufacturing yields the adjusted estimate of gross manufacturing product.

Finally, all these calculations and adjustments give the total estimate of gross state product for the state of Pennsylvania. This procedure was used to calculate gross product for each of the six states for the years 1960, 1965, 1970, and 1975. The calculation for 1970 is shown below:

Worksheet for Estimating Current Dollar Gross Product Originating in the Private Non-Farm Industries, Pennsylvania, 1970[20]

Economic Sector	National Coefficients (a) YO/YR	(b) KC/YO	(c) IBT/YO	Pennsylvania Data and Estimates (millions of dollars) (d) YR	(e) YO (axd)	(f) KC (bxe)	(g) IBT (cxe)	(h) GPO (e+f+g)
Mining	1.132	.511	.188	416	470.6	240.6	88.5	800.0
Construction	1.086	.062	.031	2,253	2446.8	151.7	75.9	2674.4
Manufacturing	1.237	.101	.087	13,311	16465.7	1663.0	1432.5	19561.2
Trade	1.157	.070	.286	5,690	6583.3	460.8	1882.8	8926.9
Finance, Insurance, Real Estate	2.700	.245	.296	1,632	4406.4	1079.6	1304.3	6790.3
Transportation, Communication, Utilities	1.353	.234	.145	2,598	3515.1	822.5	509.7	4847.3
Services and Other	1.098	.081	.027	5,388	5916.0	479.2	159.7	6554.9

Manufacturing	18,051.7*
Non-manufacturing (private non-farm)	30,593.8
Total	48,645.5

*Adjusted manufacturing product,[21] for Pennsylvania VA_s/LP_s = .92283; (.92283) (19561.2) = 18,051.7.

Government	5,231.5
Farm	645.4
Private non-farm	
Mining	800.0
Construction	2,674.4
Manufacturing	18,051.7
Trade	8,926.9
Finance, insurance, and real estate	6,790.3
Transportation, communication, and utilities	4,847.3
Services and other	6,554.9
Total Gross State Product	54,522.4

Implications of the Kendrick-Jaycox Assumptions

As explained above, national ratios of income originating to income received in various industries are used to obtain estimates of state gross product. This assumption implies that within major industries factor proportions are similar or that the production function is of the constant elasticity of substitution variety. Niemi attempts to avoid this implication by adjusting for differences in the ratio of output to labor. In a recent article he examined the appropriateness of the assumption that manufacturing proportions were similar in all states.[22] He detected differences sufficient enough to suggest that caution be used in making the assumption of similar factor proportions.

Niemi points out, however, that this bias in manufacturing can be adjusted and that theoretically the bias should be less significant in the service industries and in non-manufacturing industries that have relatively high labor inputs. Most of the private non-farm sectors (except mining) fall into one of these categories. Furthermore, Neimi found that, among others, the states of Ohio, Illinois, and Indiana were quite representative of the national output to labor ratio in 1960 and 1965. He found that the national output to labor ratio assumption would result in an error of less than 4.5% in the case of these states. In 1965 these states accounted for 66% of total ORBES gross product.

To get an approximation of the ORBES gross regional product, the gross state product for each state was multiplied by the ratio of ORBES employment in that sector divided by total state employment in that sector. Employment information by industry is available on a county basis in the appropriate state volumes of the decennial U.S. census of population and elsewhere. The following correspondences were assumed between the census categories and the gross state product sectors:

Sector	Census Category
Government	Services and other (see below)

Sector	Census Category
Farm	Agriculture, forestry, and fisheries
Private non-farm	
Mining	Mining
Construction	Construction
Manufacturing	Manufacturing
Trade	Wholesale trade; food, bakery and dairy stores; eating and drinking places; general merchandise retailing; motor vehicle retailing and service stations; other retail trade
Finance, insurance, and real estate	Bank and credit agencies; insurance, real estate, and other finance
Transportation, communication, and utilities	Railroads and railway express services; trucking service and warehousing; other transportation; communications; utilities and sanitary services
Services and Other	Business and repair services, private households; other personal services; entertainment and recreation services; hospitals; health services, except hospitals; elementary, secondary schools, and colleges--government; elementary, secondary schools--private; other education and kindred services; welfare, religious, and nonprofit membership organizations; legal, engineering, and miscellaneous professional services; public administration

Because it was impossible to break out government employment from the various service categories (for example, hospital employment was not categorized as being government or private) the "services and other" ratio was also used to estimate the ORBES gross government product.

Employment is the only consistent measure available on a county basis, and county data are needed to calculate the ORBES portion of state economic activity. Value added is available at the county level for some of the sectors (e.g., manufacturing and mining) but not others. Rather than use a value-added ratio for some sectors and an employment ratio for others, it was

felt that it would be more appropriate to consistently use employment ratios to calculate ORBES product. Further, we checked the 1972 factors for manufacturing and mining, using value added against those using employment and obtained almost identical results. Consequently, it appears that using the employment ratio as a multiplier is a reasonable method to allocate each state product to the appropriate ORBES area.

Detailed results of the above methodology are reported in Tables A-1 to A-24 in Appendix A.

NOTES

1. Personal income statistics are available on a county basis in the U.S. Department of Commerce, Survey of Current Business, August issues.

2. Ratajczak, D., and R. Williams, "The Case for a Gross State Product Series," Growth and Change, Vol. 3, No. 2, April 1972, p. 29.

3. Niemi, A. W., Jr., Gross State Product and Productivity in the Southeast (Chapel Hill: University of North Carolina Press, 1975).

4. Romans, J. T., and E. A. Trott, Jr., Gross State Products: The Estimates and Their Uses.

5. Kendrick, J. W., and C. M. Jaycox, "The Concept and Estimation of Gross State Product," Southern Economic Journal, October 1965, pp. 153-158.

6. L'Esperance, W. L., and D. Fromm, "A Note on Estimating Gross State Product," Growth and Change, Vol. 5, No. 2, April 1974, pp. 46-47.

7. Niemi, Gross State Product and Productivity.

8. Romans and Trott, Gross State Products.

9. Polenske, K., et al., State Estimates of the Gross National Product, 1974, 1958, 1963 (Lexington, Mass.: D. C. Heath and Co., 1972).

10. Scheppach, R. C., Jr., State Projections of the Gross National Product, 1970, 1980 (Lexington, Mass.: D. C. Heath and Co., 1972).

11. L'Esperance, W., C. Baird, and A. Shumay, "A Comparison of Estimates of Gross State Product," Department of Economics, Ohio State University, Winter 1978, preliminary working paper.

12. Ibid., p. 43.

13. The clearest description of the Kendrick and Jaycox procedure of calculating gross regional product is given by Niemi, Gross State Product and Productivity, pp. 9-15.

14. The state government wage and salary data are given in the August issues of the Survey of Current Business.

15. U.S. Department of Agriculture, Economic Research Service, Farm Income, State Estimates, 1959-1971, supplement to the July 1972 Farm Income Situation, August 1972.

16. For 1970 figures see Survey of Current Business, July 1971, Table 1.22.

17. The relatively minor components of "business transfer payments" (in 1976 these accounted for less than .5 percent of gross national product) and "subsidies less current surplus of government enterprises" (in 1976 less than .05 percent of gross national product) are ignored.

18. Niemi, Gross State Product and Productivity, pp. 10-11.

19. Niemi, Gross State Product and Productivity, p. 12.

20. The table format is from Niemi, Gross State Product and Productivity, p. 12. National coefficients for 1970 were calculated from the following sources: income received, table 70, Survey of Current Business, August 1971, p. 37; income originating, table 1.12, Survey of Current Business, July 1971, p. 17; capital consumption allowances and indirect business taxes, table 1.22, Survey of Current Business, July 1971, p. 21.

21. 1970 Annual Survey of Manufactures, General Statistics for Industry Groups and Industries, p. 4, and Statistics for Divisions and States, parts 5, 6, and 7.

22. Niemi, A. W., Jr., "A Re-Examination of the Kendrick-Jaycox Method of Estimating Gross State Product," Review of Regional Studies, Vol. 2, No. 3, Spring 1972, p. 123.